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FINAL REPORT

19990285

NATIVE PRAIRIE MAPPING TO SUPPORT AGRICULTURAL RESOURCE MANAGEMENT

Funded by
The Agriculture Development Fund

March 2002
Prepared by: Native Plant Society of Saskatchewan

SAF
Saskatchewan Agriculture & Food

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Native Prairie Mapping to Support Agricultural Resource Management

Project No. 19990285

Final Report

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Native Prairie Mapping to Support Agricultural Resource Management

Project No. 19990285

A.M. Hammermeister (Native Plant Society of Saskatchewan Inc.) and D. Gauthier (Canadian Plains Research Center)

February, 2002

Summary

A seamless map of land cover classes in the Prairie Ecozone was generated from digital satellite imagery. Statistical analysis of the distribution of cover classes in ecoregion classification units (i.e., ecozone, ecoregion, and landscape area) and watershed was conducted. The quantity and distribution of Native Dominant Grassland (NDG), which is dominated by native vegetation, in each of these units was analyzed in detail. An overlay of NDG on soil agricultural capability maps was conducted. An extension publication was produced discussing the quantity and distribution of NDG in the prairie ecozone and the importance of stewardship and conservation. Only 21% of NDG remains in the Prairie Ecozone, with as little as 6% in some landscape areas of the Aspen Parkland and Moist Mixed Grassland ecoregions. NDG is most abundant in the Mixed Grassland ecoregion where 31% remains. Approximately 75% of remaining NDG occurs on land that is severely limited or unsuitable for crop production. This statistic suggests that there is a poor representation of NDG on good agricultural land. Further work is needed to determine the quality of remaining NDG and ownership statistics in relation to patch size before a comprehensive conservation strategy can be developed.

Technical Report

Background

Conservation of the remaining native prairie is critical as a genetic and physical resource for agricultural development, environmental protection and management, research, and social well-being. Detailed information related to the nature and distribution of remaining native prairie does not exist. That information is essential to meet a vision of sustaining a healthy native prairie in which natural and human values are respected. It will also provide baseline information to address biodiversity and restoration objectives relevant to agriculture and a broad set of environmental interests. This baseline information is also critical in meeting many information needs for policy development and management of remaining native grasslands.

Objective

The project is intended to provide detailed baseline information regarding the nature and distribution of native prairie in Saskatchewan for the purpose of managing and conserving remaining native grassland. Within the scope of the project, there are four key objectives:

- Integration of 335 SDLC (Southern Digital Land Cover) digital images into a seamless GIS-compatible digital coverage.
- Analyze the nature and extent of native prairie relative to ecoregion classification units (i.e., ecozone, ecoregion, and landscape area) and watershed.
- Analyze the nature and extent of native prairie relative to soil capability classes.
- Communicate the results of the work to the public.

Project Activities and Achievements

This project has fulfilled its objectives as outlined above. The Canadian Plains Research Centre (CPRC) completed integration of the seamless images and analyzed the nature and extent of native prairie in different ecoregion classification units, watersheds and in relation to different soil capability classes. The Native Plant Society of Saskatchewan (NPSS) prepared an extension publication upon completion of these analyses including maps of native prairie distribution; 10,000 copies were printed. The publication was made publicly available.

The seamless mapping and data analysis was conducted in two phases with reports prepared at the completion of each phase. A detailed description of methods, discussion of results and communication efforts are presented in the appendices of this report as follows:

Appendix A: Seamless map development, ecological land classification and watershed overlay and statistical report.
Appendix B: Soil capability overlay and statistical report.
Appendix C: PFRA and SAF Native Prairie Crown Land overlay.
Appendix D: Text copy of the extension publication "Saskatchewan's Native Prairie: Taking Stock of a Vanishing Ecosystem and Dwindling Resource".
Appendix E: Press release.

To date over 3,500 copies of the extension publication have been distributed or made available for distribution by various organizations throughout the province. A press release was issued in February 2002 to newspapers throughout the province. Distribution highlights have included:

- 350 copies distributed to livestock producers and professionals as part of the registration package at the Saskatchewan Forage and Grazing Conference held in Saskatoon.
- 450 copies to Nature Conservancy of Canada (NCC) for distribution to land stewards.
- 250 copies to the NPSS membership.
- 50 copies to Rural Service Centres (extra copies subsequently distributed).
- 300 copies to the Saskatchewan Wetland Conservation Corporation (SWCC) for distribution to stewards.
- 150 copies sent to each Ducks Unlimited (DU) office in Saskatchewan.
- 150 copies to PFRA.
- 300 copies to the Meewasin Valley Authority in Saskatoon.
- 450 copies to Rural Municipality offices.

The publication is rapidly becoming the primary reference for the quantity and distribution of native prairie in the province (as was intended). We have received calls from NCC, SWCC and DU asking permission to use the data and maps in presentations to landowners across the province. The booklet will be used as a reference in a Canadian Wildlife Service presentation being given at a conservation conference in California. The publication has also been requested by SIAST for educational purposes. Two invitations to present the data have been received. The publication is already having a significant impact despite having only been released for 3 months. A seminar of the results of this work will be presented at a Society for Range Management Luncheon to be held on March 1, 2002.

Summary of Results

The Prairie Ecozone is estimated to include nearly 241,000 km^2 of land. Only 21% of Prairie Ecozone is classified as Native Dominant Grassland as compared with 68% classified as Cropland.

Approximately 20% of Saskatchewan's native grassland occurs in the Aspen Parkland ecoregion. Within this ecoregion, however, native grassland occupies only 13% of the landscape; over 71% of has been cultivated. Because of the favourable climate, trees and shrubs occupy over 9% of the land area. The Aspen Parkland contains more wetlands than any other prairie ecoregion. Native grassland remaining in the 22 landscape areas of this ecoregion ranges from 6% in the Quill Lake Plain (north of the Quill Lakes) to 37% in the Lower Battle River Plain and the Ribstone Plain in the western part of the ecoregion. Although this is the most productive grassland ecoregion in the province, it is also the most fragmented, overused and threatened by exotic species.

Like the Aspen Parkland, 20% of the remaining native grassland in the province occurs in the Moist Mixed Grassland ecoregion. Over 76% of the land base has been cultivated

leaving only 16% of the ecoregion as native grassland. In its 20 landscape areas, remaining native grassland ranges from 46% of the land area in the Neutral Hills (the most westerly area of the ecoregion) to 6% in the Griffin Plain (the Estevan/Weyburn area).

Over 50% of remaining native grassland in Saskatchewan occurs in the Mixed Grassland ecoregion. Overall, 31% of the land area is occupied by native grassland and 62% is cultivated. There are 25 landscape areas in this ecoregion. Native grassland cover ranges from 78% in the Great Sandhills to 14% in the Lake Alma Upland in the southeast corner of the ecoregion. Overall, native prairie occurs in the largest parcels, is in best condition and is least threatened in this ecoregion.

Only 7% percent of all native grassland in the province occurs in the Cypress Upland ecoregion. Due to soil limitations and a ranching tradition, however, this area has been least disturbed by cultivation (22%) with over 70% of the land area remaining as native grassland.

Approximately 75% of remaining native grassland occurs on land that is severely limited or unsuitable for crop production. Most of these areas are unsuitable for cultivation due to soil moisture limitations, stones, steep slopes, erosion, salinity, soil structure or flooding. Over 24% of native grassland is still at medium or high risk of being broken (Soil classes 1 to 3). Only 10% of the remaining native grassland occurs on highly productive soil (i.e., Soil Class 1 or 2). These areas are at highest risk of cultivation. They need to be saved as a benchmark for the future and a reserve of biodiversity.

Discussion and Conclusions

The results of this work indicate that only 21% of the native prairie remains. To some, this statistic may suggest that there is sufficient representation of native grassland remaining in the province. A more detailed consideration, however, reveals that the native grassland is under significant threat.

Due to differences in soil and climate, it is reasonable to assume that each Landscape Area of the province supported a unique ecosystem. Conserving a representative area of native grassland within each Landscape Area is therefore important. However, as little as 6% native grassland remains in some landscape areas. These ecosystems have been all but lost. In the interest of biodiversity, incentives should be provided to and measures should be taken to ensure that remaining native prairie is conserved and enhanced.

Large contiguous blocks of native grassland are relatively uncommon, as is illustrated in the attached maps and the results of Dr. Paul James' research (see reference with Table 3 in extension publication). Fragmentation increases the risk of invasion by exotic species by increasing the amount of 'edge' surrounding the grassland. Fragmentation interrupts the flow of wildlife, including plants, from one region to the next, thereby jeopardizing the genetic diversity within the ecosystem. According to Dr. James, grassland in parcels smaller than 250 ha may not provide sufficient habitat to sustain representative levels of species diversity.

An understanding of this ownership distribution is essential for developing comprehensive management strategies. A detailed analysis of the proportion of native grassland that is privately owned, Crown owned and managed and leased from the Crown (i.e. privately managed) is needed. This ownership analysis should also account for the size and location of native grassland parcels. There will be increasing pressure on the Crown to manage native grassland in a sustainable manner, particularly if the Crown is found to be the major landowner. The Crown may have to introduce and possibly enforce management guidelines on leased land.

Further Work

This work, and the resulting publication, is a valuable resource outlining the quantity and location of native prairie remaining in the province. It is a first step. A full assessment of the resource would also include an assessment of the quality of native grassland and ownership data. With this information, a comprehensive strategy for prairie conservation could be developed. Until this strategy is developed, landowners and managers need to become aware of the value of native grassland, and the importance of conservation is essential. This education will, in part, be addressed by further distribution of the extension publication produced from this work.

Acknowledgement

The Saskatchewan Department of Agriculture and Food (SAF) is recognized as a supporter of this project and partner of the Native Plant Society of Saskatchewan via the NPSS website, annual meeting, promotional materials, press releases and our newsletter. Sources of funding for the project are also recognized at presentations. SAF is also recognized in the extension publication.

Equipment

No equipment was purchased for this project.

Project Developed Materials

Copies of the extension publication "Saskatchewan's Native Prairie: Taking Stock of a Vanishing Ecosystem and Dwindling Resource" are enclosed.

Appendices

Appendix 'A': Seamless map development, ecological land classification and watershed overlay and statistical report.

Native Prairie Mapping to Support Agricultural Resource Management

ADF Project No. 19990285

September 27, 2000

CANADIAN PLAINS RESEARCH CENTER

SUMMARY

This project is intended to provide detailed baseline information regarding the nature and distribution of native prairie in Saskatchewan. This information will be used to support management and conservation of remaining native grassland and to develop a bulletin for extension purposes. Project activities to date include the overlay of digital land cover data with ecological land classification data and watersheds within Saskatchewan's prairie ecozone. This information was downloaded into Excel spreadsheets with each file containing land cover types occurring within a specific ecological land classification unit and watershed. The area (km^2) and percentage of each land cover class within each ecoregion were calculated. Furthermore, for each ecoregion, the area (km^2) and percentage of each land cover class were calculated for each landscape area.

TECHNICAL REPOR

Background and Objectives

The overall project is intended to provide detailed baseline information regarding the nature and distribution of native prairie in Saskatchewan for the purpose of managing and conserving remaining native grassland. Within the scope of the project, there are four key objectives:

(1) Integration of 335 SDLC (Southern Digital Land Cover) digital images into a seamless GIS-compatible digital coverage.
(2) Analyze the nature and extent of native prairie relative to ecoregion classification units (i.e., ecozone, ecoregion, and landscape area) and watershed.
(3) Analyze the nature and extent of native prairie relative to soil capability classes.
(4) Communicate the results of the work to the public.

In meeting the above objectives a number of results are expected and these are to be provided according to a five-phase project timetable. These five milestones and their respective completion dates are outlined below, as follows:

Milestone 1 April 30, 2000	Completion of a seamless GIS-compatible digital coverage of all 335 SDLC digital images, including a native prairie map.
Milestone 2 September 2000	Completion of ecological land classification and watershed overlay and statistical report.
Milestone 3 December 2000	Completion of soil capability for agriculture overlay and statistical report.
Milestone 4 January 2001	Completion of a printed map of remnant prairie with statistics for public distribution.
Milestone 5 March 2001	Completion of an extension bulletin describing the nature and extent of remaining prairie in Saskatchewan. Release and distribution of extension bulletin.

This report deals with Milestone 2. This phase involves the overlay and spatial analysis of digital land cover data with ecological land classification data (i.e., ecozone, ecoregion and landscape areas) and watersheds within Saskatchewan's prairie ecozone. The four ecozones within Saskatchewan are shown in Figure 1.

Project Activities

The work was done in two stages. The first stage involved the overlay of digital coverages and the second stage involved compilation and analysis of resultant tabular information. The coverages used were derived from three data sets that varied in terms of their spatial extent, spatial referencing systems, and data structures. To begin, a description of these data sets will be given, followed by a discussion of the overlay and analysis procedures.

Digital Data Sets Used

(1) Seamless Southern Digital Land Cover (SDLC) digital data file
(2) Ecozone , Ecoregion and Landscape Area digital data files
(3) PFRA's Gross Watershed Digital Data Files

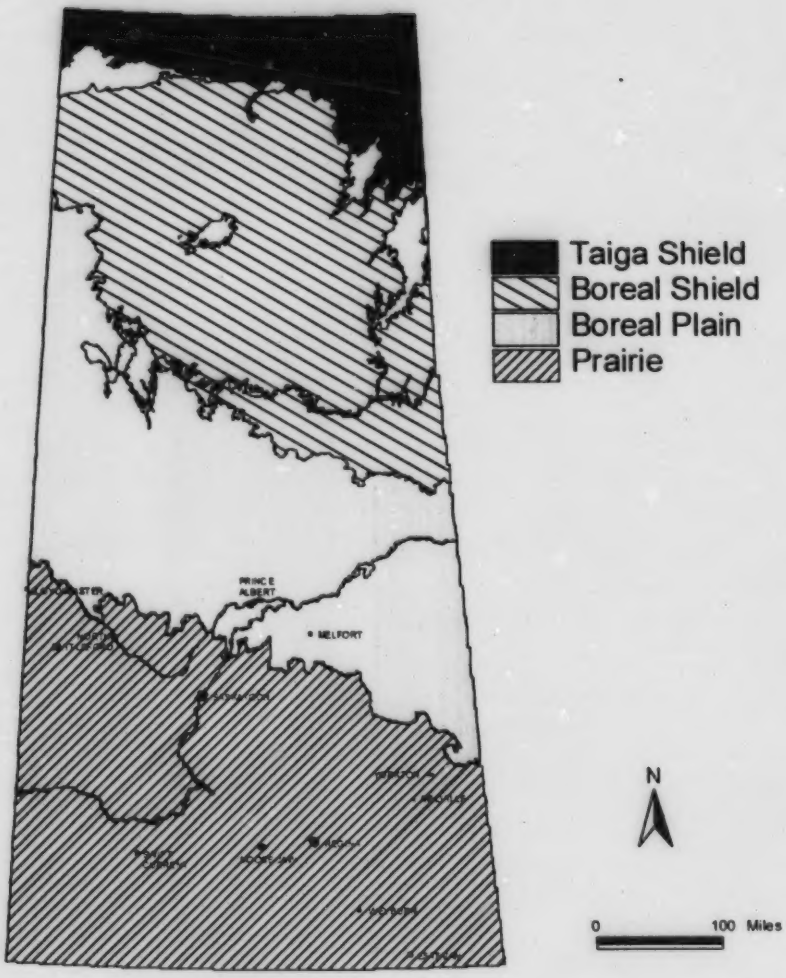

Figure 1. Ecozones of Saskatchewan

1. Southern Digital Land Cover (SDLC) 1994 Digital Data Files

The SDLC is a digital file comprising 335 1:50,000 digital land cover map sheets produced by the Saskatchewan Research Council (SRC) as part of the Southern Digital Land Cover Project for Saskatchewan. The land cover data files display 26 possible land cover classes, which have been derived through satellite image analysis. A description of the 26 land cover classes is provided in Appendix 1.

PFRA provided a seamless composite TIFF image of the 335 original 1:50,000 digital land cover map sheets. The file was provided in TIFF format, Universal Transverse Mercator extended zone 13 projection, and datum NAD83. Each pixel represents an area of 30 metres by 30 metres.

2. Ecozone, Ecoregion and Landscape Area Digital Data Files

The ecological land classification data sets used include a coverage comprising all four of Saskatchewan's ecozones, a second file representing a subdivision of the first data file into 11 ecoregions, and a third coverage including all of the 69 landscape areas represented within the Prairie Ecozone of Saskatchewan. Appendix 2 includes a listing of the landscape areas and their codes for each of the ecoregions belonging to the prairie ecozone. The files were in Arc export format, Universal Transverse Mercator projection, Zone 13 and NAD83.

3. PFRA's Watershed Digital Data Files

PFRA has created and continues to maintain a watershed database, containing GIS data files of watershed boundaries and hydrometric gauging station locations. The database encompasses all three Prairie Provinces as well as adjoining drainage basins in British Columbia, the Northwest Territories, Ontario, and the United States. Background information on the watershed project, including how watershed boundaries are defined is available on the Internet (www.agr.ca/pfra/gis/chernesk.pdf).

The watershed database digital files are available in Arc export format, geographic projection and NAD83. The format and types of files available are detailed in Appendix 3. The file used in this project is an Arc/Info coverage (hw1g_pf.e00) containing 2401 watershed polygons based on hydrometric gauging stations. PFRA provides attribute data attached to each of the 2401 polygons. Attribute *ws_maj12* defines 12 major watersheds with an approximate scale of 1:250,000. Attribute *ws_maj33* defines 33 major watersheds at an approximate scale of 1:100,000. Figure 2. shows the three levels of watershed polygons. The watershed names for the both the 33 and the 12 small-scale watersheds, as well as the numerical codes associated with the 33 watersheds are provided in Appendix 4.

Overlay Procedure

The digital data files varied in terms of their spatial areas and formats. Therefore, prior to performing the overlay procedure, three variables needed to be standardized: (1) spatial extent; (2) data structure for storing and processing the digital data files; and (3) projection parameters. In order to meet these requirements, many of the data files needed to be processed and modified, as described below. The resultant files used for analysis are listed and described in Table 2.

Spatial Extent

The spatial extent of the prairie ecozone of Saskatchewan corresponds to the study area. New files were created from the ecozone, ecoregion, and landscape area files in which only the features that resided within the spatial boundary corresponding to the prairie ecozone were included.

The watershed data file was generalized using the dissolve command in Arc/Info in order to reduce the 2401 watershed polygons based on hydrometric gauges into 33 small-scale watersheds. The watershed file was then clipped so that only the watersheds within the prairie ecozone of Saskatchewan would be represented, leaving16 watersheds.

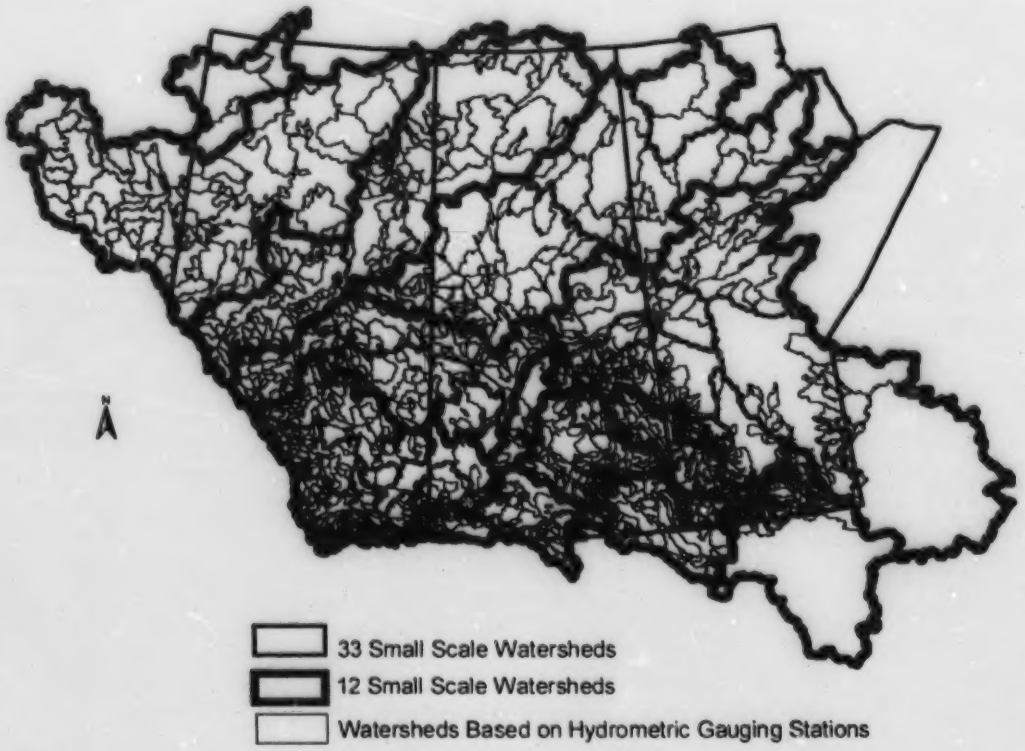

Figure 2. Three levels of watersheds within PFRA's Watershed Digital Data Files

Table 2. Resultant data files used for overlay and analysis

File Name	Description
precozone_g	a grid file containing the prairie ecozone
precoreg_g	a grid file containing the four landscape areas belonging to the prairie ecozone
prlanarea_g	a grid file containing all 69 of the landscape areas belonging to the prairie ecozone
pr_watsh83_g	a grid file containing 16 of 33 small scale watersheds (most of the watershed polygons represent only a portion of the actual watershed boundary)
sdlc_g	the southern digital land cover data in grid format

Some results of clipping the watersheds should be noted. First, since most of the watersheds cross provincial and international borders, and ecozone boundaries, most of the watersheds in the resultant clipped coverage represent only a portion of the actual watershed. Second, some portions within the clipped area along the US/Saskatchewan border show no watershed. This

occurs where the watershed is primarily included within the US and only a very small area extends into Saskatchewan.

Data Structure For Storing And Processing The Digital Data Files

The overlay of the digital map data was done in ArcInfo using the GRID module, a raster or cell-based data storage and processing tool integrated in ArcInfo. Data processing was done in a raster format because the size of the SDLC data file made processing in a vector environment difficult. The seamless composite SDLC data file was converted from image (TIFF) into raster GRID format. The data files containing ecozone, ecoregion, landscape area and watershed data within the prairie ecozone were converted from ARC/INFO vector coverages to ARC/INFO raster-based grid files. All files were gridded to a cell size of 30 metres by 30 metres corresponding to the original SDLC pixel size.

Projection Parameters

All datasets were standardized to the following projection parameters:

Projection: Universal Transverse Mercator, zone 13
Units: meters
Datum: NAD83.

Once the three requirements detailed above were met, the SDLC data was analyzed according to the ecological land classification units (i.e., ecozone, ecoregion and landscape areas) and watersheds units resulting in both graphic and tabular interpretations of the type and distribution of the land cover classes.

Analysis

The results of the spatial analysis were downloaded from the ArcInfo GIS into spreadsheet software (Excel). Each file contained land cover types occurring within a specific ecological land classification unit and watershed. In some cases a "0" value was present where portions of the polygon were unclassified.

Within Excel, the area extent of each land cover class was calculated as a percentage of the total area of each ecological land classification unit and watershed analyzed. The results of the analysis are provided in Appendices 5 through 10. Appendix 5 provides a breakdown of the area in km^2 and % of each SDLC by ecoregion within the Prairie ecozone. Land cover area totals by landscape area are provided in the next four appendices and are organized by ecoregion, with Appendix 6 through 9 corresponding to Cypress Upland, Mixed Grassland, Moist Mixed Grassland, and Aspen Parkland ecoregions, respectively. The four ecoregions within the prairie ecozone as well as selected landscape areas are depicted in Figure 3. The watershed results are provided in Appendix 10.

Although area calculations were performed on all ecological land classification units, the calculations used to depict the results of the analysis for ecozone and ecoregions were derived from the landscape area totals. These totals were checked against the results obtained for files built separately on each ecoregion and on the prairie ecozone. Minor discrepancies in the area totals were noticed due to conversion errors associated with vector to raster conversion, with an increase in error occurring with files containing a greater number or boundaries.

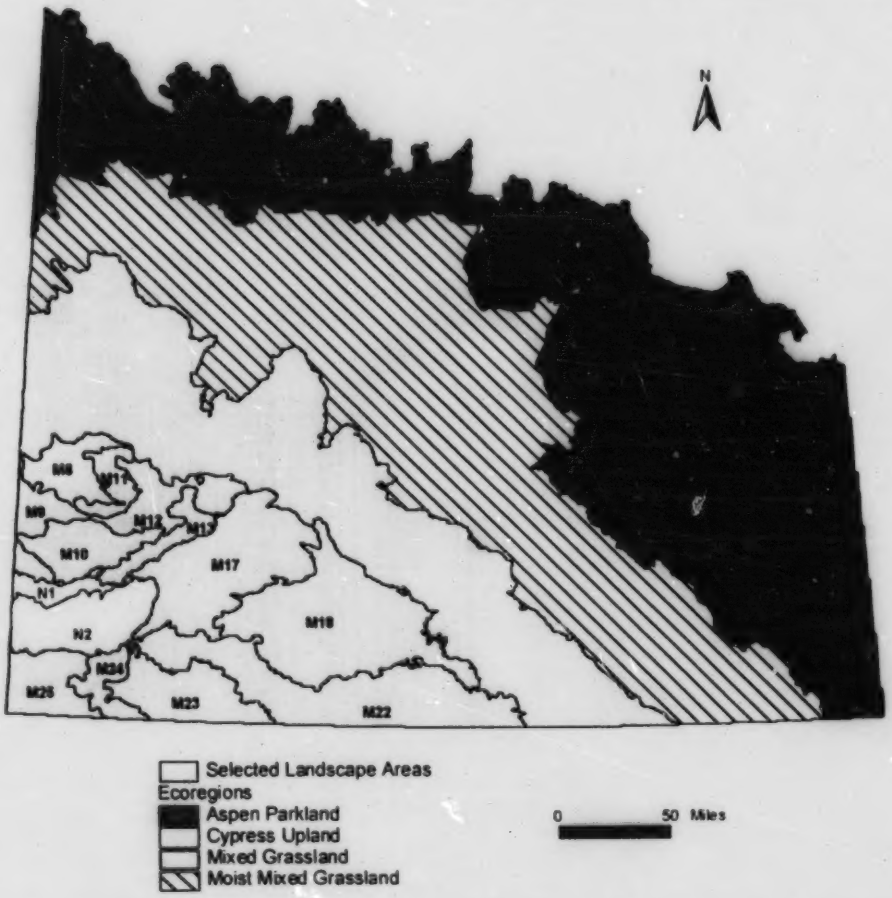

Figure 3. Ecoregions and Selected Landscape Areas within Saskatchewan's Prairie Ecozone

Appendix 'A' Sub-Appendix 1 - Description on of Southern Digital Land Cover Classes

Class #	Type	Description
1	Crop Land	All lands dedicated to the production of annual cereal, oil seed and other specialty crops, and typically cultivated on an annual basis
2	Hay Crops - Forage	Alfalfa and alfalfa/tame grass mixtures
3	Native Dominant Grasslands	Native dominant grasslands/may contain tame grasses and herbs
4	Tall Shrubs	Communities containing both low and tall shrub, snowberry, saskatoon, chokecherry, buffaloberry, and willow
5	Pasture - Seeded Grasslands	Grasslands dominated by tame grass species
6	Hardwoods - Open Canopy	Corresponds to Provincial Forest Inventory: over 75% hardwoods; 10-30% crown closure
7	Hardwoods - Closed Canopy	Corresponds to Provincial Forest Inventory: over 75% hardwoods; 30-100% crown closure
8	Jack Pine - Closed Canopy	Similar to Provincial Forest Inventory: 75% or greater Jack Pine; 30-100% crown closure
9	Jack Pine - Open Canopy	Similar to Provincial Forest Inventory: 75% or greater Jack Pine; 10-30% crown closure
10	Spruce - Closed Canopy	Similar to Provincial Forest Inventory: 75% or greater Black and White Spruce; 10-30% crown closure
11	Spruce - Open Canopy	Similar to Provincial Forest Inventory: 75% or greater Black and White Spruce; 10-30% crown closure
12	Mixed Woods	All softwood/hardwood mixtures
13	Treed Rock	Areas of exposed bedrock with generally less then 10% tree cover. Dominant species are Jack Pine and Black Spruce.
14	Recent Burns	All areas that have been recently burned over by wildfires.
15	Revegetating Burns	Burns with a regrowth of commercial timber generally 1-5 metres in height.
16	Cutovers	Areas where commercial timber has been completely or partially removed by logging operations.
17	Water Bodies	Consists of all open water - lakes, rivers, streams, ponds and lagoons.
18	Marsh	Dominated by sedge and wetland grasses.
19	Herbaceous Fen	Fens dominated by herbaceous species.
20	Mud/Sand/Saline	
21	Shrub Fen - Treed Swamp	Fens dominated by shrubby species.

22	Treed Bog	Peat-covered or peat-filled depressions with a high water table and surface carpet of moss, chiefly sphagnum. The bogs have 25% or more canopy by trees greater than one metre tall. The primary species is Black Spruce.
23	Open Bog	Peat-covered or peat-filled depressions with a high water table and a surface carpet of moss, chiefly sphagnum.
24	Farmstead	Farmstead types, towns, cities, exposed areas with little or no vegetation, or cloud coverage.
25 & 26	Slopes	Steep valley slopes or hill slopes where aspect and slope prohibit classification.

Appendix 'A' Sub-**Appendix 2 - Codes and Descriptions of Landscape Areas occupying the four prairie ecoregions of Saskatchewan**

Aspen Parkland

LA Code	*Description*
H1	Lloydminster Plain
H2	Lower Battie River Plain
H3	Ribstone Plain
H4	Provost Plain
H5	Maymont Plain
H6	Whitewood Hills
H7	Hafford Plain
H8	Waldheim Plain
H9	Cudworth Plain
H10	Quill Lake Plain
H11	Touchwood Hills Upland
H12	Whitesand Plain
H13	Yorkton Plain
H14	St. Lazarre Plain
H15	Melville Plain
H16	Indian Head Plain
H17	Kipling Plain
H18	Moose Mountain Upland
H19	Moose Mountain
H20	Gainsborough Plain
H21	Moose Mountain Creek Plain
H22	Oak Lake Plain

Moist Mixed Grassland

LA Code	*Description*
K1	Neutral Hills
K2	Tramping Lake Plain
K3	Senlac Hills
K4	Biggar Plain
K5	Bear Hills
K6	Rosetown Plain
K7	Goose Lake Plain
K8	Saskatoon Plain
K9	Moose Wood Sand Hills
K10	Minichinas Upland
K11	Elstow Plain
K12	Allan Hills
K13	Arm River Plain
K14	Last Mountain Lake Plain
K15	Strasbourg Plain

Mixed Grassland

LA Code	*Description*
M1	Kerrobert Plain
M2	Sibbald Plain
M3	Oyen Upland
M4	Eston Plain
M5	Bad Hills
M6	Acadia Valley Plain
M7	Bindloss Plain
M8	Hazlet Plain
M9	Schuler Plain
M10	Maple Creek Plain
M11	Great Sand Hills
M12	Antelope Creek Plain
M13	Gull Lake Plain
M14	Beechy Hills
M15	Coteau Hills
M16	Chaplin Plain
M17	Swift Current Plateau
M18	Wood River Plain
M19	Dirt Hills
M20	Coteau Lakes Upland
M21	Lake Alma Upland
M22	Wood Mountain Plateau
M23	Climax Plain
M24	Old Man on His Back Plateau
M25	Wild Horse Plain

Cypress Upland

LA Code	*Description*
N1	Cypress Slope
N2	Cypress Hills

K16	Eyebrow Plain
K17	Regina Plain
K18	Griffin Plain
K19	Trossachs Plain
K20	Souris River Plain

Appendix 'A' Sub-**Appendix 3**

PFRA WATERSHED PROJECT, VERSION 2.0

This document contains information on watershed project data. It is written for the data user, and assumes that the user does not have the version 1.0 data. Topic headings:

Introduction
What Is Available
Data
What's New in Version 2.0
Documentation
Graphics
Projecting Themes in ArcView
Project History
The Future
Updates
For More Information

The content of this Appendix has not been included.

For More Information

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Intranet: available only to AAFC staff at http://agrisource.ncr.agr.ca/pfra
The intranet site contains a paper on the methodology for step three of the project.
Internet: available to all at http://aceis.agr.ca/pfra/
The intranet site contains the free data and a paper on the methodology for step three of the project.

Appendix 'A' Sub-Appendix 4 - Codes and Descriptions of the 33 Small-Scale and 12 Smaller-Scale Watersheds Within the Three Prairie Provinces (Alberta, Saskatchewan and Manitoba)

Code	Name of major watershed (1 of 33)	Name of major watershed (1 of 12)
1	Hay River	Hay River
2	Peace River and Slave River	Peace River
3	Athabasca River above Athabasca	Athabasca River
4	Athabasca River below Athabasca	Athabasca River
5	Seal River	Churchill River
6	Churchill River above junction with Reindeer River	Churchill River
7	Churchill River below junction with Reindeer River	Churchill River
8	North Saskatchewan River above Edmonton	North Saskatchewan River
9	Battle River	North Saskatchewan River
10	Eagle Creek	North Saskatchewan River
11	North Saskatchewan River between Edmonton and The Forks	North Saskatchewan River
12	Red Deer River	South Saskatchewan River
13	Bow River	South Saskatchewan River
14	Oldman River	South Saskatchewan River
15	Seven Persons Creek - Bigstick Lake - Swift Current Creek	South Saskatchewan River
16	South Saskatchewan River	South Saskatchewan River
17	Carrot River	Nelson River
18	Saskatchewan River below the Forks	Nelson River
19	Quill Lakes	Qu'Appelle River
20	Assiniboine River above junction with QuAppelle River	Assiniboine River
21	Qu'Appelle River	Qu'Appelle River
22	Souris River	Souris River
23	Assiniboine River below junction with Qu'Appelle River	Assiniboine River
24	Red River	Red River
25	Lake Winnipegosis	Nelson River
26	Dauphin Lake	Nelson River
27	Lake Manitoba	Nelson River
28	Winnipeg River - Lake Winnipeg	Nelson River
29	Nelson River below Lake Winnipeg	Nelson River
30	Milk River	Missouri River
31	Lodge Creek - Battle Creek - Frenchman River	Missouri River
32	Wood River	Missouri River
33	Poplar River	Missouri River

Appendix 'A' Sub-**Appendix 5**

Area in km^2 and percentage of each SDLC (Southern Digital Land Cover) class by Ecoregion within the Prairie Ecozone of Saskatchewan.

		Aspen Parkland		Mixed Grassland		Moist Mixed Grassland		Cypress Upland		ECOZONE TOTALS	
SDLC Classes & Codes		km2	%	km2	%	km2	%	km2	%	km2	%
0	Unclassified	48.23	0.1%	114.22	0.1%	24.71	0.0%	1.77	0.0%	188.93	0.1%
1	Crop Land	58646.07	69.3%	51209.82	59.3%	49773.46	73.4%	1061.70	21.2%	158691.05	65.9%
2	Hay Crops - Forage	816.23	1.0%	980.99	1.1%	1009.60	1.5%	20.73	0.4%	2827.54	1.2%
3	Native Dominant Grasslands	10542.83	12.9%	27018.06	31.3%	10523.30	15.5%	3558.21	70.9%	51642.41	21.4%
4	Tall Shrubs	3731.49	4.6%	1449.66	1.7%	1064.65	1.6%	111.69	2.2%	6357.49	2.6%
5	Pasture - Seeded Grasslands	641.34	0.8%	1065.30	1.2%	504.13	0.7%	20.73	0.4%	2231.51	0.9%
6	Hardwoods - Open Canopy	3133.62	3.8%	175.57	0.2%	614.55	0.9%	114.85	2.3%	4038.60	1.7%
7	Hardwoods - Closed Canopy	666.59	0.8%	0.26	0.0%	11.48	0.0%	0.00	0.0%	678.33	0.3%
8	Jack Pine - Closed Canopy	0.46	0.0%	0.00	0.0%	0.00	0.0%	22.25	0.4%	22.71	0.0%
9	Jack Pine - Open Canopy	1.64	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	1.64	0.0%
10	Spruce - Closed Canopy	0.41	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.41	0.0%
11	Spruce - Open Canopy	0.54	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.54	0.0%
12	Mixed Woods	10.06	0.0%	0.00	0.0%	0.00	0.0%	11.90	0.2%	21.97	0.0%
13	Treed Rock	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
14	Recent Burns	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
15	Revegetating Burns	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
16	Cutovers	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
17	Water Bodies	2064.84	2.5%	1696.15	2.0%	1550.38	2.3%	47.73	1.0%	5359.09	2.2%
18	Marsh	2027.96	2.5%	1316.67	1.5%	1627.26	2.4%	36.49	0.7%	5008.38	2.1%
19	Herbaceous Fen	69.23	0.1%	100.91	0.1%	136.50	0.2%	0.00	0.0%	306.64	0.1%
20	Mud/Sand/Saline	503.30	0.6%	749.57	0.9%	210.61	0.3%	2.48	0.0%	1465.97	0.6%
21	Shrub Fen - Treed Swamp	0.03	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.03	0.0%
22	Treed Bog	1.99	0.0%	0.02	0.0%	0.00	0.0%	0.01	0.0%	2.02	0.0%
23	Open Bog	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%
24	Farmstead	626.12	0.8%	544.46	0.6%	780.97	1.2%	8.79	0.2%	1960.34	0.8%
25	Slopes	0.10	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.10	0.0%
26	Slopes	159.44	0.2%	0.00	0.0%	0.00	0.0%	0.00	0.0%	159.44	0.1%
	ECOREGION TOTALS	81692.52	100.0%	86421.67	100.0%	67831.60	100.0%	5019.35	100.0%	240965.14	100.0%

Appendix 'A' Sub-**Appendix 6**

Area in km^2 and percentage of each SDLC (Southern Digital Land Cover) class by LA (Landscape Area) within the Cypress Upland Ecoregion of Saskatchewan.

LA	Southern Digital Land Cover Classes														LA Totals
	0	1	2	3	4	5	6	8	12	17	18	20	22	24	
N1	1.43	253.35	10.27	622.53	21.39	12.96	7.65			5.28	10.54	0.24	0.01	1.23	946.88
	0.2%	*26.8%*	*1.1%*	*65.7%*	*2.3%*	*1.4%*	*0.8%*			*0.6%*	*1.1%*	*0.0%*	*0.0%*	*0.1%*	*100.0%*
N2	0.34	808.35	10.46	2935.68	90.30	7.78	107.20	22.25	11.90	42.45	25.96	2.24	0.00	7.56	4072.47
	0.0%	*19.8%*	*0.3%*	*72.1%*	*2.2%*	*0.2%*	*2.6%*	*0.5%*	*0.3%*	*1.0%*	*0.6%*	*0.1%*	*0.0%*	*0.2%*	*100.0%*
Ecoregion Totals	1.77	1061.70	20.73	3558.21	111.69	20.73	114.85	22.25	11.90	47.73	36.49	2.48	0.01	8.79	5019.35
	0.0%	*21.2%*	*0.4%*	*70.9%*	*2.2%*	*0.4%*	*2.3%*	*0.4%*	*0.2%*	*1.0%*	*0.7%*	*0.0%*	*0.0%*	*0.2%*	*100.0%*

Appendix 'A' Sub-Appendix 7

Area in km^2 and percentage of each SDLC (Southern Digital Land Cover) class by LA (Landscape Area) within the Mixed Grassland Ecoregion of Saskatchewan.

LA	Southern Digital Land Cover Classes														LA Totals
	0	1	2	3	4	5	6	7	17	18	19	20	22	24	
M1		1784.22	23.64	612.78	35.61	12.47	0.43		67.88	107.11		2.91		12.10	2659.14
		67.1%	*0.9%*	*23.0%*	*1.3%*	*0.5%*	*0.0%*		*2.6%*	*4.0%*		*0.1%*		*0.5%*	*100.0%*
M2		845.69	17.39	205.07	1.54	12.73	0.21		22.45	33.28		3.47	0.01	5.13	1146.97
		73.7%	*1.5%*	*17.9%*	*0.1%*	*1.1%*	*0.0%*		*2.0%*	*2.9%*		*0.3%*	*0.0%*	*0.4%*	*100.0%*
M3		774.04	3.47	665.72	1.89	4.58	0.43		19.74	20.82		2.25		5.84	1498.58
		51.7%	0.2%	44.4%	0.1%	0.3%	0.0%		1.3%	1.4%		0.1%		0.4%	100.0%
M4		6928.18	58.87	1614.85	48.02	25.40	6.53	0.01	260.66	101.70	0.12	25.31		56.12	9125.77
		75.9%	*0.6%*	*17.7%*	*0.5%*	*0.3%*	*0.1%*	*0.0%*	*2.9%*	*1.1%*	*0.0%*	*0.3%*		*0.6%*	*100.0%*
M5		949.86	20.60	566.73	19.59	9.90	0.78	0.24	10.54	19.93		12.82		3.45	1614.43
		58.8%	*1.3%*	*35.1%*	*1.2%*	*0.6%*	*0.0%*	*0.0%*	*0.7%*	*1.2%*		*0.8%*		*0.2%*	*100.0%*
M6		95.75	2.51	35.96	0.06		0.01		0.09	1.36		0.07		0.55	136.37
		70.2%	*1.8%*	*26.4%*	*0.0%*		*0.0%*		*0.1%*	*1.0%*		*0.1%*		*0.4%*	*100.0%*
M7		365.01	6.28	284.55	72.58	0.89	19.65		13.72	0.89		1.34		1.51	766.62
		47.6%	*0.8%*	*37.1%*	*9.5%*	*0.1%*	*2.6%*		*1.8%*	*0.1%*		*0.2%*		*0.2%*	*100.0%*
M8		1736.39	3.71	382.21	13.96	3.89	0.58		17.45	30.90		7.31	0.00	7.26	2203.66
		78.8%	*0.2%*	*17.3%*	*0.6%*	*0.2%*	*0.0%*		*0.8%*	*1.4%*		*0.3%*	*0.0%*	*0.3%*	*100.0%*
M9	0.14	1061.51	3.23	637.82	7.26	1.73	2.50		11.39	19.22		2.71		2.10	1749.62
	0.0%	*60.7%*	*0.2%*	*36.5%*	*0.4%*	*0.1%*	*0.1%*		*0.7%*	*1.1%*		*0.2%*		*0.1%*	*100.0%*
M10		527.47	5.85	1940.39	35.42	1.68	3.92		58.36	52.63		28.68		6.59	2660.99
		19.8%	*0.2%*	*72.9%*	*1.3%*	*0.1%*	*0.1%*		*2.2%*	*2.0%*		*1.1%*		*0.2%*	*100.0%*
M11		155.59		969.80	98.43		3.16		3.71	2.69		8.43	0.00	0.94	1242.75
		12.5%		*78.0%*	*7.9%*		*0.3%*		*0.3%*	*0.2%*		*0.7%*	*0.0%*	*0.1%*	*100.0%*
M12		1988.41	37.22	518.81	5.94	17.56	0.57		59.00	25.76		8.27		16.65	2678.17
		74.2%	*1.4%*	*19.4%*	*0.2%*	*0.7%*	*0.0%*		*2.2%*	*1.0%*		*0.3%*		*0.6%*	*100.0%*
M13		787.13	12.34	638.04	20.18	9.20	2.03		30.55	9.49		3.21		8.25	1520.42
		51.8%	*0.8%*	*42.0%*	*1.3%*	*0.6%*	*0.1%*		*2.0%*	*0.6%*		*0.2%*		*0.5%*	*100.0%*
M14		1426.69	35.22	1135.72	65.53	14.65	2.67		126.50	24.70	2.88	14.36		8.52	2857.44
		49.9%	*1.2%*	*39.7%*	*2.3%*	*0.5%*	*0.1%*		*4.4%*	*0.9%*	*0.1%*	*0.5%*		*0.3%*	*100.0%*
M15		1079.49	18.42	245.91	81.60	26.21	0.71		25.78	12.94	1.70	1.73		3.36	1497.84
		72.1%	*1.2%*	*16.4%*	*5.4%*	*1.7%*	*0.0%*		*1.7%*	*0.9%*	*0.1%*	*0.1%*		*0.2%*	*100.0%*
M16		4022.12	108.19	1476.67	224.60	58.97	6.54		449.42	127.03		193.94		45.24	6712.71
		59.9%	*1.6%*	*22.0%*	*3.3%*	*0.9%*	*0.1%*		*6.7%*	*1.9%*		*2.9%*		*0.7%*	*100.0%*
M17		5632.05	148.98	1404.21	32.22	129.00	3.61		92.25	42.65		14.03		89.42	7588.43
		74.2%	*2.0%*	*18.5%*	*0.4%*	*1.7%*	*0.0%*		*1.2%*	*0.6%*		*0.2%*		*1.2%*	*100.0%*
M18		7627.24	202.82	1456.61	17.64	287.99	20.26		107.63	200.35		57.44		98.26	10076.24
		75.7%	2.0%	14.5%	0.2%	2.9%	0.2%		1.1%	2.0%		0.6%		1.0%	100.0%
M19		1682.62	72.09	1110.12	344.35	14.01	7.05		27.01	71.57		4.95		15.22	3349.00
		50.2%	*2.2%*	*33.1%*	*10.3%*	*0.4%*	*0.2%*		*0.8%*	*2.1%*		*0.1%*		*0.5%*	*100.0%*
M20	12.06	3785.24	73.14	2107.16	148.61	57.72	8.93		133.31	165.11	55.42	145.58		56.44	6728.73
	0.2%	56.0%	1.1%	31.3%	2.2%	0.9%	0.1%		2.0%	2.5%	0.8%	2.2%		0.8%	100.0%
M21	13.93	1511.34	10.86	295.66	81.04	29.19	4.45		33.51	82.56	40.50	18.10		17.63	2138.78
	0.7%	*70.7%*	*0.5%*	*13.8%*	*3.8%*	*1.4%*	*0.2%*		*1.6%*	*3.9%*	*1.9%*	*0.8%*		*0.8%*	*100.0%*
M22	42.49	3185.75	87.86	4862.45	75.61	177.62	78.00		79.80	72.65	0.29	163.65		57.69	8883.86
	0.5%	*35.9%*	*1.0%*	*54.7%*	*0.9%*	*2.0%*	*0.9%*		*0.9%*	*0.8%*	*0.0%*	*1.8%*		*0.6%*	*100.0%*
M23	20.86	2257.47	4.75	1034.21	11.24	155.19	0.43		19.89	71.71		17.05		17.76	3610.57
	0.6%	*62.5%*	*0.1%*	*28.6%*	*0.3%*	*4.3%*	*0.0%*		*0.6%*	*2.0%*		*0.5%*		*0.5%*	*100.0%*
M24	7.31	417.92	0.05	924.02	4.27	4.65	0.06		2.60	7.87		1.52		2.96	1373.23
	0.5%	*30.4%*	*0.0%*	*67.3%*	*0.3%*	*0.3%*	*0.0%*		*0.2%*	*0.6%*		*0.1%*		*0.2%*	*100.0%*
M25	17.42	602.65	23.48	1892.58	2.48	10.08	1.87		22.89	11.76		10.46		5.69	2601.36
	0.7%	*23.2%*	*0.9%*	*72.8%*	*0.1%*	*0.4%*	*0.1%*		*0.9%*	*0.5%*		*0.4%*		*0.2%*	*100.0%*
Ecoregion Totals	**114.22**	**81209.82**	**980.99**	**27018.06**	**1449.66**	**1065.30**	**175.57**	**0.26**	**1696.15**	**1316.67**	**100.91**	**749.57**	**0.02**	**544.46**	**86421.67**
	0.1%	*59.3%*	*1.1%*	*31.3%*	*1.7%*	*1.2%*	*0.2%*	*0.0%*	*2.0%*	*1.5%*	*0.1%*	*0.9%*	*0.0%*	*0.6%*	*100.0%*

Appendix 'A' Sub-**Appendix 8**

Area in km^2 and percentage of each SDLC (Southern Digital Land Cover) class by LA (Landscape Area) within the Moist Mixed Grassland Ecoregion of Saskatchewan.

	Southern Digital Land Cover Classes													LA
LA	0	1	2	3	4	5	6	7	17	18	19	20	24	Totals
K1		554.81	15.67	568.35	13.55	11.58	0.45		19.73	55.51		2.14	3.71	1245.51
		44.5%	*1.3%*	*45.6%*	*1.1%*	*0.9%*	*0.0%*		*1.6%*	*4.5%*		*0.2%*	*0.3%*	*100.0%*
K2		4974.48	97.54	1047.84	54.96	12.25	15.68		191.59	318.47		20.51	42.96	6776.29
		73.4%	*1.4%*	*15.5%*	*0.8%*	*0.2%*	*0.2%*		*2.8%*	*4.7%*		*0.3%*	*0.6%*	*100.0%*
K3		313.83	9.10	190.89	12.08	0.34	12.12		11.22	47.46		2.80	3.53	603.37
		52.0%	*1.5%*	*31.6%*	*2.0%*	*0.1%*	*2.0%*		*1.9%*	*7.9%*		*0.5%*	*0.6%*	*100.0%*
K4		256.15	10.39	211.92	49.99		2.04	4.26	16.11	13.78		5.24	2.11	571.99
		44.8%	*1.8%*	*37.0%*	*8.7%*		*0.4%*	*0.7%*	*2.8%*	*2.4%*		*0.9%*	*0.4%*	*100.0%*
K5		743.71	10.77	360.85	26.90	1.21	9.73	0.09	18.52	23.97		3.20	2.11	1201.06
		61.9%	*0.9%*	*30.0%*	*2.2%*	*0.1%*	*0.8%*	*0.0%*	*1.5%*	*2.0%*		*0.3%*	*0.2%*	*100.0%*
K6		3609.08	28.15	407.92	12.55	8.90	1.11	0.52	79.47	45.32	7.83	12.15	18.59	4231.59
		85.3%	*0.7%*	*9.6%*	*0.3%*	*0.2%*	*0.0%*	*0.0%*	*1.9%*	*1.1%*	*0.2%*	*0.3%*	*0.4%*	*100.0%*
K7		3347.57	106.68	924.43	165.10	95.56	40.89	2.30	248.78	117.91		29.91	26.30	5105.42
		65.6%	*2.1%*	*18.1%*	*3.2%*	*1.9%*	*0.8%*	*0.0%*	*4.9%*	*2.3%*		*0.6%*	*0.5%*	*100.0%*
K8		679.03	29.77	154.74	12.69	0.90	46.34	0.57	16.35	29.73	0.19	1.28	104.79	1076.38
		63.1%	*2.8%*	*14.4%*	*1.2%*	*0.1%*	*4.3%*	*0.1%*	*1.5%*	*2.8%*	*0.0%*	*0.1%*	*9.7%*	*100.0%*
K9		626.50	58.34	832.52	174.44	39.35	303.68	3.69	37.79	21.45	1.06	13.49	18.50	2130.79
		29.4%	*2.7%*	*39.1%*	*8.2%*	*1.8%*	*14.3%*	*0.2%*	*1.8%*	*1.0%*	*0.0%*	*0.6%*	*0.9%*	*100.0%*
K10		696.88	3.07	178.96	7.45	4.15	10.95		26.25	34.44	5.36	8.69	2.39	978.61
		71.2%	*0.3%*	*18.3%*	*0.8%*	*0.4%*	*1.1%*		*2.7%*	*3.5%*	*0.5%*	*0.9%*	*0.2%*	*100.0%*
K11		3724.07	53.14	514.58	14.24	86.75	25.80		163.17	109.27	42.62	40.55	39.61	4813.81
		77.4%	*1.1%*	*10.7%*	*0.3%*	*1.8%*	*0.5%*		*3.4%*	*2.3%*	*0.9%*	*0.8%*	*0.8%*	*100.0%*
K12		839.73	6.58	227.91	1.38	13.70	0.61		31.97	45.21	8.22	6.44	1.75	1183.50
		71.0%	*0.6%*	*19.3%*	*0.1%*	*1.2%*	*0.1%*		*2.7%*	*3.8%*	*0.7%*	*0.5%*	*0.1%*	*100.0%*
K13		6071.14	62.02	831.94	92.16	44.52	31.98		141.96	108.64	8.17	13.20	41.78	7447.53
		81.5%	*0.8%*	*11.2%*	*1.2%*	*0.6%*	*0.4%*		*1.9%*	*1.5%*	*0.1%*	*0.2%*	*0.6%*	*100.0%*
K14		1303.65	26.85	415.76	4.33	75.65	0.47		191.79	60.25	24.31	10.91	9.93	2123.89
		61.4%	*1.3%*	*19.6%*	*0.2%*	*3.6%*	*0.0%*		*9.0%*	*2.8%*	*1.1%*	*0.5%*	*0.5%*	*100.0%*
K15		3560.72	80.07	447.12	78.42	10.37	31.93		38.01	67.29	5.52	9.16	24.65	4353.26
		81.8%	*1.8%*	*10.3%*	*1.8%*	*0.2%*	*0.7%*		*0.9%*	*1.5%*	*0.1%*	*0.2%*	*0.6%*	*100.0%*
K16		1737.18	79.01	647.35	58.27	43.04	20.17	0.05	85.60	19.91		7.24	11.49	2709.32
		64.1%	*2.9%*	*23.9%*	*2.2%*	*1.6%*	*0.7%*	*0.0%*	*3.2%*	*0.7%*		*0.3%*	*0.4%*	*100.0%*
K17		7823.87	164.56	620.77	88.12	9.86	25.36		53.70	70.28		4.25	228.70	9089.49
		86.1%	*1.8%*	*6.8%*	*1.0%*	*0.1%*	*0.3%*		*0.6%*	*0.8%*		*0.0%*	*2.5%*	*100.0%*
K18		5420.45	89.73	369.66	58.43	7.33	6.32		63.51	286.89	1.92	0.53	100.13	6404.92
		84.6%	*1.4%*	*5.8%*	*0.9%*	*0.1%*	*0.1%*		*1.0%*	*4.5%*	*0.0%*	*0.0%*	*1.6%*	*100.0%*
K19	5.69	2858.25	32.48	785.85	66.57	32.87	7.83		71.20	110.26	28.47	16.65	30.54	4046.64
	0.1%	*70.6%*	*0.8%*	*19.4%*	*1.6%*	*0.8%*	*0.2%*		*1.8%*	*2.7%*	*0.7%*	*0.4%*	*0.8%*	*100.0%*
K20	19.02	632.38	45.67	783.93	73.02	5.78	21.08		43.65	41.22	2.83	2.25	67.38	1738.22
	1.1%	*36.4%*	*2.6%*	*45.1%*	*4.2%*	*0.3%*	*1.2%*		*2.5%*	*2.4%*	*0.2%*	*0.1%*	*3.9%*	*100.0%*
Ecoregi	24.71	49773.46	1009.60	10523.30	1064.65	504.13	614.55	11.48	1550.38	1627.26	136.50	210.6	780.97	67831.60
Totals	*0.0%*	*73.4%*	*1.5%*	*15.5%*	*1.6%*	*0.7%*	*0.9%*	*0.0%*	*2.3%*	*2.4%*	*0.2%*	*0.3%*	*1.2%*	*100.0%*

Appendix 'A' Sub-**Appendix 9**

Area in km^2 and percentage of each SDLC (Southern Digital Land Cover) class by LA (Landscape Area) within the Aspen Parkland Ecoregion of Saskatchewan.

	Southern Digital Land Cover Classes															LA
LA	0	1	2	3	4	5	6	7	17	18	19	20	21	24	26	Totals
H1	0.01	4415.49	68.49	1318.48	514.65	245.96	427.39	21.19	113.80	171.57	4.03	36.19		54.99		7392.27
	0.0%	59.7%	0.9%	17.8%	7.0%	3.3%	5.8%	0.3%	1.5%	2.3%	0.1%	0.5%		0.7%		100.0%
H2		378.63	14.93	541.09	242.39	64.50	162.96		30.17	27.16		14.13		5.31		1481.26
		25.6%	1.0%	36.5%	16.4%	4.4%	11.0%		2.0%	1.8%		1.0%		0.4%		100.0%
H3		152.40	9.81	418.44	215.43	14.66	158.81		126.51	19.13		18.06		1.68		1145.14
		13.3%	0.9%	36.5%	18.8%	1.3%	14.7%		11.0%	1.7%		1.6%		0.1%		100.0%
H4		222.27	7.02	78.67	4.83		2.36		7.01	14.90		1.48		3.06		341.60
		65.1%	2.1%	23.0%	1.4%		0.7%		2.1%	4.4%		0.4%		0.9%		100.0%
H5		1826.26	24.63	291.06	66.07	10.41	69.40		117.93	43.64		18.56		29.53		2497.49
		73.1%	1.0%	11.7%	2.6%	0.4%	2.8%		4.7%	1.7%		0.7%		1.2%		100.0%
H6		1895.66	31.77	649.82	200.77	40.50	360.50	6.09	139.81	97.48		18.13	0.02	8.69		3452.86
		54.9%	0.9%	18.8%	5.8%	1.2%	10.4%	0.2%	4.0%	2.8%		0.5%	0.0%	0.3%		100.0%
H7		417.57	19.11	164.06	44.76	5.80	38.97	2.10	10.91	18.43		2.66		2.99		727.35
		57.4%	2.6%	22.6%	6.2%	0.8%	5.4%	0.3%	1.5%	2.5%		0.4%		0.4%		100.0%
H8		3062.55	70.18	493.83	77.81	8.12	130.51	0.66	114.70	121.78		20.62		32.84		4134.72
		74.1%	1.7%	11.9%	1.9%	0.2%	3.2%	0.0%	2.8%	2.9%		0.5%		0.8%		100.0%
H9		1745.44	27.94	221.71	9.48	6.16	110.05		107.55	90.57		14.08		14.41		2347.40
		74.4%	1.2%	9.4%	0.4%	0.3%	4.7%		4.6%	3.9%		0.6%		0.6%		100.0%
H10		8140.20	127.66	618.15	233.28	81.35	145.01	61.06	634.16	123.43	16.15	245.32	0.01	102.69		10536.58
		77.3%	1.2%	5.9%	2.2%	0.8%	1.4%	0.6%	6.0%	1.2%	0.2%	2.3%	0.0%	1.0%		100.0%
H11		7527.05	71.05	1083.39	551.49	27.44	372.32	82.47	152.36	292.82	4.08	50.89		85.41		10300.77
		73.1%	0.7%	10.5%	5.4%	0.3%	3.6%	0.8%	1.5%	2.8%	0.0%	0.5%		0.8%		100.0%
H12		610.76	15.25	486.51	181.15	17.17	151.84	14.06	90.02	33.33	12.98	7.03		14.05		1634.16
		37.4%	0.9%	29.8%	11.1%	1.1%	9.3%	0.9%	5.5%	2.0%	0.8%	0.4%		0.9%		100.0%
H13		4606.18	48.53	740.50	178.22	42.38	164.78	2.30	79.46	206.35	28.97	29.90		67.29	8.70	6203.55
		74.3%	0.8%	11.9%	2.9%	0.7%	2.7%	0.0%	1.3%	3.3%	0.5%	0.5%		1.1%	0.1%	100.0%
H14	12.97	194.50	11.90	184.61	86.10	47.12	46.26	7.70	9.78	9.37	1.06	3.82		1.73	5.64	623.22
	2.1%	31.2%	1.9%	29.6%	13.8%	7.6%	7.4%	1.2%	1.6%	1.5%	0.2%	0.6%		0.3%	0.9%	100.0%
H15	24.97	6036.87	46.72	698.69	452.19	5.77	157.63	135.55	77.24	123.64		2.96		56.78	140.31	7960.72
	0.3%	75.8%	0.6%	8.8%	5.7%	0.1%	2.0%	1.7%	1.0%	1.6%		0.0%		0.7%	1.8%	100.0%
H16		2549.58	22.16	484.29	18.46		132.26		86.79	55.74		0.70		44.44		3394.40
		75.1%	0.7%	14.3%	0.5%		3.9%		2.6%	1.6%		0.0%		1.3%		100.0%
H17		4137.74	47.69	632.14	200.57	18.72	177.06	22.60	44.80	157.64	1.88	11.18		27.25	4.71	5483.98
		75.5%	0.9%	11.5%	3.7%	0.3%	3.2%	0.4%	0.8%	2.9%	0.0%	0.2%		0.5%	0.1%	100.0%
H18		2189.82	18.73	310.27	53.87	3.94	27.12	1.11	26.28	82.53	0.07	1.70		24.78		2740.20
		79.9%	0.7%	11.3%	2.0%	0.1%	1.0%	0.0%	1.0%	3.0%	0.0%	0.1%		0.9%		100.0%
H19		214.62	3.19	146.56	86.41		207.76	297.59	56.42	153.65		1.00		6.81		1174.01
		18.3%	0.3%	12.5%	7.4%		17.7%	25.3%	4.8%	13.1%		0.1%		0.6%		100.0%
H20	9.37	4851.25	102.89	494.52	219.53	0.38	75.49	11.96	11.42	125.67		4.55		27.81	0.08	5934.91
	0.2%	81.7%	1.7%	8.3%	3.7%	0.0%	1.3%	0.2%	0.2%	2.1%		0.1%		0.5%	0.0%	100.0%
H21		840.30	21.28	384.90	59.60		3.33		21.38	48.55		0.36		5.27		1384.96
		60.7%	1.5%	27.8%	4.3%		0.2%		1.5%	3.5%		0.0%		0.4%		100.0%
H22	0.92	630.95	5.31	101.13	34.45	0.96	1.83	0.17	6.37	10.59				8.29		800.97
	0.1%	78.8%	0.7%	12.6%	4.3%	0.1%	0.2%	0.0%	0.8%	1.3%				1.0%		100.0%
Ecoreg.	48.23	88646.07	816.23	10542.83	3731.49	641.34	3133.62	686.59	2064.84	2027.96	69.23	503.30	0.03	626.12	159.44	81692.52
Totals	0.1%	89.3%	1.0%	12.9%	4.6%	0.8%	3.8%	0.8%	2.5%	2.5%	0.1%	0.6%	0.0%	0.8%	0.2%	100.0%

Appendix 'A' Sub-Appendix 10

Area in km^2 and percentage of each SDLC (Southern Digital Land Cover) class by Watershed within the Prairie Ecozone of Saskatchewan.

Water-shed	Southern Digital Land Cover Classes																			Totals
	0	1	2	3	4	5	6	7	8	9	10	11	12	17	18	19	20	24	26	
10	3	12498	232	3710	804	182	965	23	0	2	0	0	2	557	463	16	107	111	0	19676
	0%	64%	1%	19%	4%	1%	5%	0%	0%	0%	0%	0%	0%	3%	2%	0%	1%	1%	0%	100%
13		1732	17	130	6	8	74	6	0	0	0	0	7	156	50	1	16	13	0	2216
		78%	1%	6%	0%	0%	3%	0%	0%	0%	0%	0%	0%	7%	2%	0%	1%	1%	0%	100%
14		994	34	9	75	3	34	20	0	0	0	0	1	44	12	0	32	10	0	1268
		78%	3%	1%	6%	0%	3%	2%	0%	0%	0%	0%	0%	3%	1%	0%	3%	1%	0%	100%
15	12	5361	105	2209	685	249	472	3	0	0	0	0	0	293	309	1	60	51	0	9810
	0%	55%	1%	23%	7%	3%	5%	0%	0%	0%	0%	0%	0%	3%	3%	0%	1%	1%	0%	100%
16	2	122	3	149	2	0	5	0	0	0	0	0	0	4	2	0	0	1	0	288
	1%	42%	1%	52%	1%	0%	2%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%	0%	0%	100%
17	7	21074	431	7034	699	372	444	4	0	0	0	0	0	1056	469	27	142	290	0	32048
	0%	66%	1%	22%	2%	1%	1%	0%	0%	0%	0%	0%	0%	3%	1%	0%	0%	1%	0%	100%
18		11525	173	3233	219	40	53	12	0	0	0	0	0	351	507	0	42	87	0	16242
		71%	1%	20%	1%	0%	0%	0%	0%	0%	0%	0%	0%	2%	3%	0%	0%	1%	0%	100%
20		6358	69	879	244	27	174	11	0	0	0	0	0	474	208	2	203	91	0	8741
		73%	1%	10%	3%	0%	2%	0%	0%	0%	0%	0%	0%	5%	2%	0%	2%	1%	0%	100%
21	5	38284	677	6217	1236	261	700	186	0	0	0	0	0	848	845	84	113	481	150	50089
	0%	76%	1%	12%	2%	1%	1%	0%	0%	0%	0%	0%	0%	2%	2%	0%	0%	1%	0%	100%
22	4	7783	94	1779	729	117	440	74	0	0	0	0	0	268	288	45	52	122	0	11795
	0%	66%	1%	15%	6%	1%	4%	1%	0%	0%	0%	0%	0%	2%	2%	0%	0%	1%	0%	100%
25	26	766	10	73	60	0	9	17	0	0	0	0	0	2	6	0	1	7	0	978
	3%	78%	1%	7%	6%	0%	1%	2%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%	100%
26	7	6537	117	6243	210	74	78	0	3	0	0	0	4	172	152	0	55	71	0	13724
	0%	48%	1%	45%	2%	1%	1%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%	1%	0%	100%
29	0	15277	409	4592	287	417	52	0	0	0	0	0	0	543	419	1	268	213	0	22480
	0%	68%	2%	20%	1%	2%	0%	0%	0%	0%	0%	0%	0%	2%	2%	0%	1%	1%	0%	100%
30		21772	333	3894	904	91	440	324	0	0	0	0	0	362	1007	65	51	306	9	29359
		74%	1%	13%	3%	0%	1%	1%	0%	0%	0%	0%	0%	1%	3%	0%	0%	1%	0%	100%
31	5	4327	86	8223	86	158	68	0	20	0	0	0	8	115	123	0	182	36	0	13436
	0%	32%	1%	61%	1%	1%	1%	0%	0%	0%	0%	0%	0%	1%	1%	0%	1%	0%	0%	100%
32		3333	35	1733	39	128	39	0	0	0	0	0	0	80	82	8	53	60	0	5590
		60%	1%	31%	1%	2%	1%	0%	0%	0%	0%	0%	0%	1%	1%	0%	1%	1%	0%	100%
Totals	70	157743	2825	49908	6286	2127	4046	681	23	2	1	1	23	5324	4943	250	1380	1949	159	237739
	0.0%	66.4%	1.2%	21.0%	2.6%	0.9%	1.7%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	2.1%	0.1%	0.6%	0.8%	0.1%	100.0%

Appendix 'B': Soil capability overlay and statistical report.

Native Prairie Mapping to Support Agricultural Resource Management
Project No. 19990285

Milestone #3
Analysis of Southern Saskatchewan Digital Land Cover according to Soil Capability for Agriculture

SUMMARY

This project is will provide detailed information regarding the nature and distribution of native prairie in Saskatchewan. This information will be used to support management and conservation of remaining native grassland and to develop a bulletin for extension purposes. Project activities to date include the overlay of digital land cover data with ecological land classification data and watersheds (Milestone #2 Report) and with agricultural soil capability data (this report). Soil capability from the Atlas of Saskatchewan was used for cover class overlays, and was compared with more detailed soil capability data from one Rural Municipalities (RM). Over 70% of remnant prairie occurs in Class 4 to 6 land where agricultural production is severely limited and/or restricted to forage production. Therefore, very little native prairie remains on "good agricultural land" and remaining natural ecosystems need to be protected. These results also indicate that further cultivation of native prairie is most likely occurring on lands where annual cropping cannot be sustained. The RM data was found to be much more detailed (and accurate), however, it is not available for all RMs. RM data should be used for detailed land management.

CANADIAN PLAINS RESEARCH CENTER

Native Plant Society of Saskatchewan, Inc.

TECHNICAL REPORT

OBJECTIVE

The overall project is intended to provide detailed baseline information regarding the nature and distribution of native prairie in Saskatchewan for the purpose of managing and conserving remaining native grassland. Within the scope of the project, there are four key objectives:

(5) Integration of 335 SDLC (Southern Digital Land Cover) digital images into a seamless GIS-compatible digital coverage.
(6) Analyze the nature and extent of native prairie relative to ecoregion classification units (i.e., ecozone, ecoregion, and landscape area) and watershed.
(7) Analyze the nature and extent of native prairie relative to soil capability classes.
(8) Communicate the results of the work to the public.

In meeting the above objectives a number of results are expected and these are to be provided according to a five-phase project timetable. These five milestones and their respective completion dates are outlined below, as follows:

Milestone 1 April 30, 2000	Completion of a seamless GIS-compatible digital coverage of all 335 SDLC digital images, including a native prairie map.
Milestone 2 September 2000	Completion of ecological land classification and watershed overlay and statistical report.
Milestone 3 December 2000	Completion of soil capability for agriculture overlay and statistical report.
Milestone 4 January 2001	Completion of a printed map of remnant prairie with statistics for public distribution.
Milestone 5 March 2001	Completion of an extension bulletin describing the nature and extent of remaining prairie in Saskatchewan. Release and distribution of extension bulletin.

PROJECT ACTIVITIES

This report deals with the third objective of the Native Prairie Mapping project, analysis of the nature and extent of native prairie relative to soil capability for agriculture. This phase involves the overlay and spatial analysis of digital land cover data for native dominant grasslands with digital soil capability for agriculture data within Saskatchewan's Prairie ecozone. This work has been completed and is described below.

As per the request of the reviewers of the last report, we have been working on differentiating Crown vs. Non-Crown prairie for the purposes of land management. This work is in progress and results will be reported at a later date. We have also initiated writing and design of the extension bulletin and map that will be made available for public distribution.

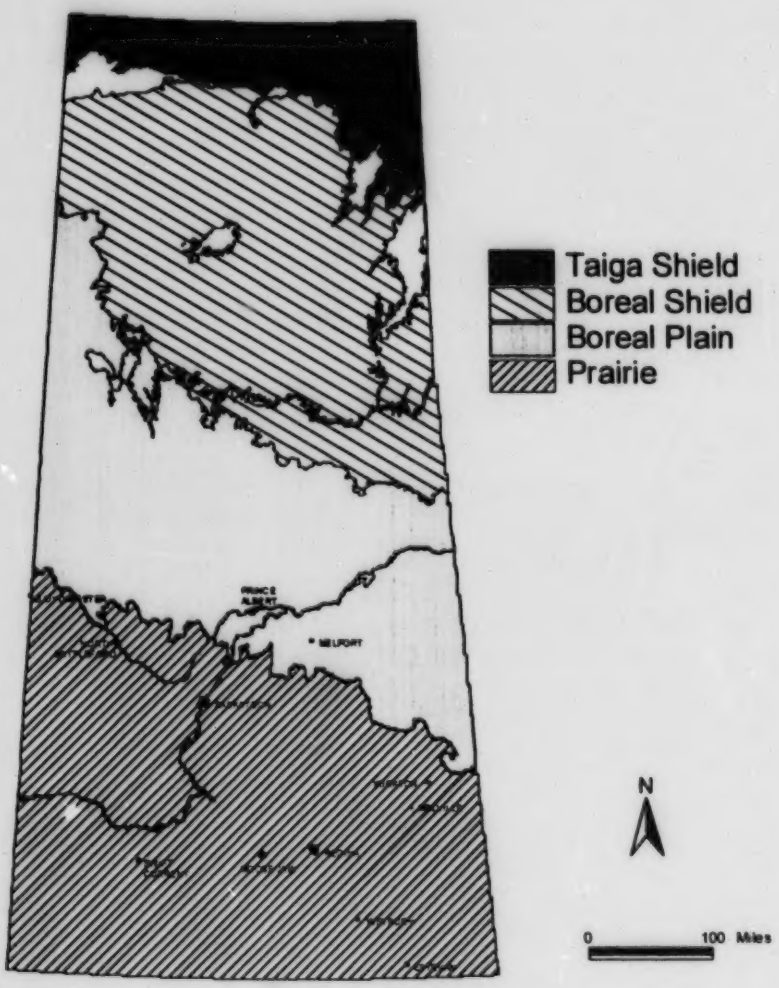


Figure 1. Ecozones of Saskatchewan

METHODS

Three digital data files were used for overlay during this phase of the project. As with the second milestone (Analysis of Southern Digital Land Cover According to Ecological Land Classification & Watershed), the Seamless Southern Digital Land Cover (SDLC) digital data file was the primary overlay coverage. For this phase of the project, however, only class 3 (Native Dominant Grasslands) of the 26 possible land cover classes was used. Appendix 1 includes a description of the 26 land cover classes.

The two other data files provide soil capability class information. They include, the digital Atlas of Saskatchewan Soil Capability for Agriculture data file and a digital 1:100,000 RM Soil Map covering RM 17 of Val Marie. Below is a more detailed description of the three data files and any required modifications made to the files prior to overlay.

Southern Digital Land Cover (SDLC) 1994 Digital Data File

The SDLC is a digital file comprising 335 1:50,000 digital land cover map sheets produced by the Saskatchewan Research Council (SRC) as part of the Southern Digital Land Cover Project for Saskatchewan. The land cover data files display 26 possible land cover classes, which have been derived through satellite image analysis

PFRA provided a seamless composite TIFF image of the 335 original 1:50,000 digital land cover map sheets. The file was provided in TIFF format, Universal Transverse Mercator extended zone 13 projection, and datum NAD83. Each pixel represents an area of 30 metres by 30 metres.

The SDLC file had been converted from TIFF format to Arc/Info's GRID format during the previous phase of the Native Prairie Mapping project. During this phase the only modification made to the SDLC coverage before it could be used for overlay analysis with the digital soil capability data was the extraction of the Native Dominant Grasslands class within the Prairie ecozone, as well as within the area covering RM #17.

Atlas of Saskatchewan Soil Capability Data File

The Atlas of Saskatchewan Soil Capability file was provided by SaskGeomatics in an Arc/Info Export format (.e00), Universal Transverse Mercator extended zone 13 projection, and datum NAD27. The digital data file includes polygons categorized by soil capability class and subclass limitations within the agricultural region of Saskatchewan. The soil capability classification consists of seven soil capability classes defined according to the degree with which they can support agriculture and an eighth category depicting organic soils, as well as 12 subclass limitations. A summary of the primary characteristics of each of the seven classes is given in Table 1.

The file was modified to show only soil capability class. The subclass limitation component was not included within the scope of this project. Also the file was clipped to cover only the Prairie ecozone (as depicted in Figure 2). The file was again clipped in order to produce a coverage containing the Atlas of Saskatchewan soil capability classes within RM 17 (see Figure 3). This was done so that a comparison between the more

general small scale representation of soil capability classes derived from the Atlas of Saskatchewan data could be made with the more detailed 1:100, 000 RM Soil data.

Table 1. Major Characteristics of Soil Capability Classes for Agricultural Land (derived from the Atlas of Saskatchewan, 1999)

Capability Class	**Degree of Limitation**	**Land Suitability**	**Productivity Rating**
1	None	*Annual field crops*	High (for wide range of crops)
2	Moderate	*Annual field crops*	High (for fairly wide range of crops)
3	Moderately Severe	*Annual field crops*	Medium (for restricted range of crops)
4	Severe	Marginal for annual cropping	Low (for narrow range of crops)
5	Very Severe	Tame pasture	Moderately high to high
6	Extremely Severe	Native pasture	Low to moderate
7	Prevents Agricultural Use	Unsuited to agricultural use	Non-productive

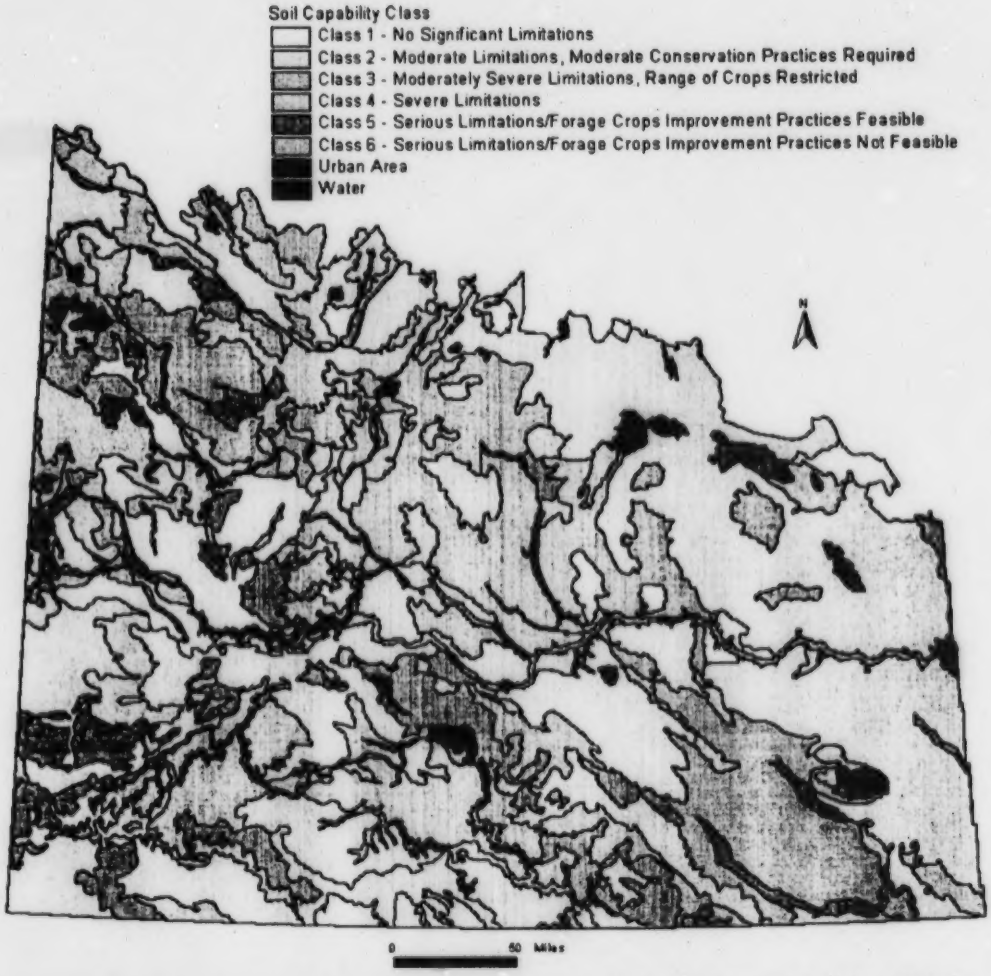

Soil Capability Class
Class 1 - No Significant Limitations
Class 2 - Moderate Limitations, Moderate Conservation Practices Required
Class 3 - Moderately Severe Limitations, Range of Crops Restricted
Class 4 - Severe Limitations
Class 5 - Serious Limitations/Forage Crops Improvement Practices Feasible
Class 6 - Serious Limitations/Forage Crops Improvement Practices Not Feasible
Urban Area
Water
N
0
60 Miles

Figure 2. Soil Capability for Agriculture Classification within the Prairie Ecozone (based on digital data derived from the Atlas of Saskatchewan Digital Data Set, 1999)

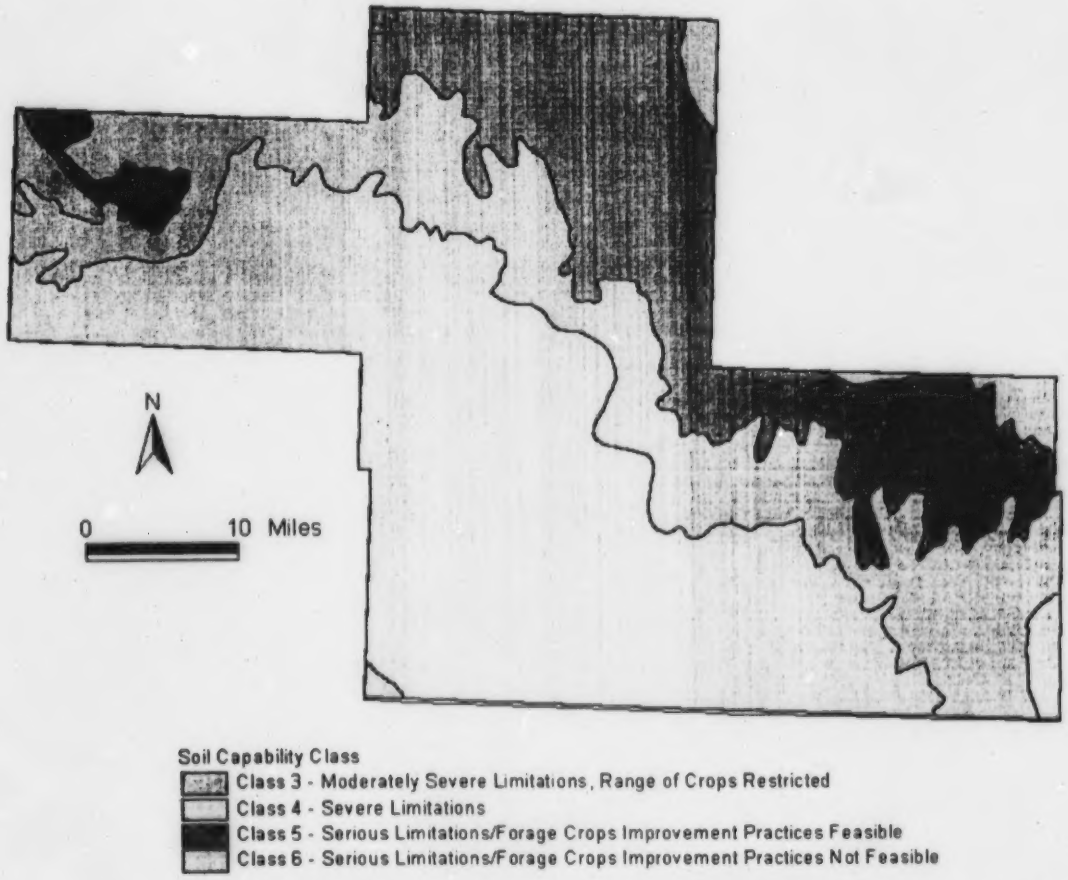

N
0
10 Miles
Soil Capability Class
Class 3 - Moderately Severe Limitations, Range of Crops Restricted
Class 4 - Severe Limitations
Class 5 - Serious Limitations/Forage Crops Improvement Practices Feasible
Class 6 - Serious Limitations/Forage Crops Improvement Practices Not Feasible

Figure 3. Soil Capability for Agriculture Classification within RM #17 - Val Marie (based on digital data derived from the Atlas of Saskatchewan Digital Data Set, 1999)

1:100,000 RM Soil Data File

The Saskatchewan Land Resource Centre at the University of Saskatchewan provided the digital 1:100,000 RM Soil data file covering RM #17. The file was in Arc/Info Export format (.e00), Universal Transverse Mercator extended zone 13 projection, and datum NAD27.

Digital soil data is available for the agricultural portion of the province at scales of 1:100,000 at the RM level and 1:125,000 for Map Sheet reports. The digital soil data is currently being georeferenced to SaskGeomatics digital 1:50,000 base maps, but is intended for use at a 1:100,000 scale. The soil map polygons are defined according to map unit and attached to each unit are a number of attributes including soil capability. Table 2 shows selected fields for 10 records extracted from the 1:100,000 RM #17 digital soils data file. The "Capblty" field contains soil capability for agriculture data where each records provides an indication of the percent of each capability class and subclass limitations associated with map unit polygon. For example, the first "Capblty" record

3(10)MT indicates that the polygon to which this record is linked is 100% capability class 3 and has subclass limitations "M" and "T" (refer to Appendix 2 for a detailed description of soil capability classes and subclasses). In some cases soil polygons share two or more capability classes. The second record 5(6)M4(4)MT indicates a soil class of 5 at 60% (with a subclass "M") and class 4 at40% (with subclasses "M" and "T).

Table 2. An example of selected records and fields from the digital 1:100,000 RM Soil attribute data file for RM 17

Unique	Mapunit	Texture	Wtld	Acidity	Irrig	Salsym	Capblty
170001	Fa1	cl-l	A1	C5	2Bqt1v	0	3(10)MT
170002	FaEe4	sl-l	A1	C5	2Dmst2	1SD	5(6)M4(4)MT
170003	VaAd1	sil-cl	A1	C5	2Bst1v	1MD	3(10)M
170004	Fa1	cl	A1	C5	2Bqt1	0	3(10)M
170005	Fa2	cl-l	A1	C3	2Dqst2	1MD	4(8)MT5(2)TP
170006	FaEe4	cl-sl	A1	C1	3Dst2	2SD	5(5)T6(2)TE4(3)MT
170007	Fa1	cl	A1	C5	2Bqst1	1MD	3(10)MT
170008	Fa2	cl-sl	A1	C3	2Cqvt2	0	3(5)T4(5)TP
170009	Fa2	sl-l	B1	C5	2Dmt2	0	5(10)TP
170010	Fa1	cl-l	A1	C3	2Cqst2	1MD	3(7)MT4(3)T

Unlike the Atlas of Saskatchewan data, which had only seven possible soil capability categories, the 1:100,000 digital RM file contained 776 records with over 250 possible categories. In order to use the file for analysis it was necessary to generalize the soil capability data. This was done by eliminating the subclass limitation indicator and by filtering out all but the dominant soil capability class within each record based on percentage. Where a record shared dominance for a capability class value a new class value showing the co-dominant classes was created. Table 3 provides and example of the tabular changes made by generalizing the soil capability value to show dominant soil capability classes. Figure 4 shows the graphic results.

Table 3. An example of selected records and fields from the modified digital 1:100,000 RM Soil attribute data file for RM 17 with the new DOM_CLASS field

Unique	Mapunit	Texture	Wtld	Acidity	Irrig	Salsym	DOM_CLASS
170001	Fa1	cl-l	A1	C5	2Bqt1v	0	3
170002	FaEe4	sl-l	A1	C5	2Dmst2	1SD	5
170003	VaAd1	sil-cl	A1	C5	2Bst1v	1MD	3
170004	Fa1	cl	A1	C5	2Bqt1	0	3
170005	Fa2	cl-l	A1	C3	2Dqst2	1MD	4
170006	FaEe4	cl-sl	A1	C1	3Dst2	2SD	5
170007	Fa1	cl	A1	C5	2Bqst1	1MD	3
170008	Fa2	cl-sl	A1	C3	2Cqvt2	0	3-4

170009	Fa2	sl-l	B1	C5	2Dmt2	0	5
170010	Fa1	cl-l	A1	C3	2Cqst2	1MD	3

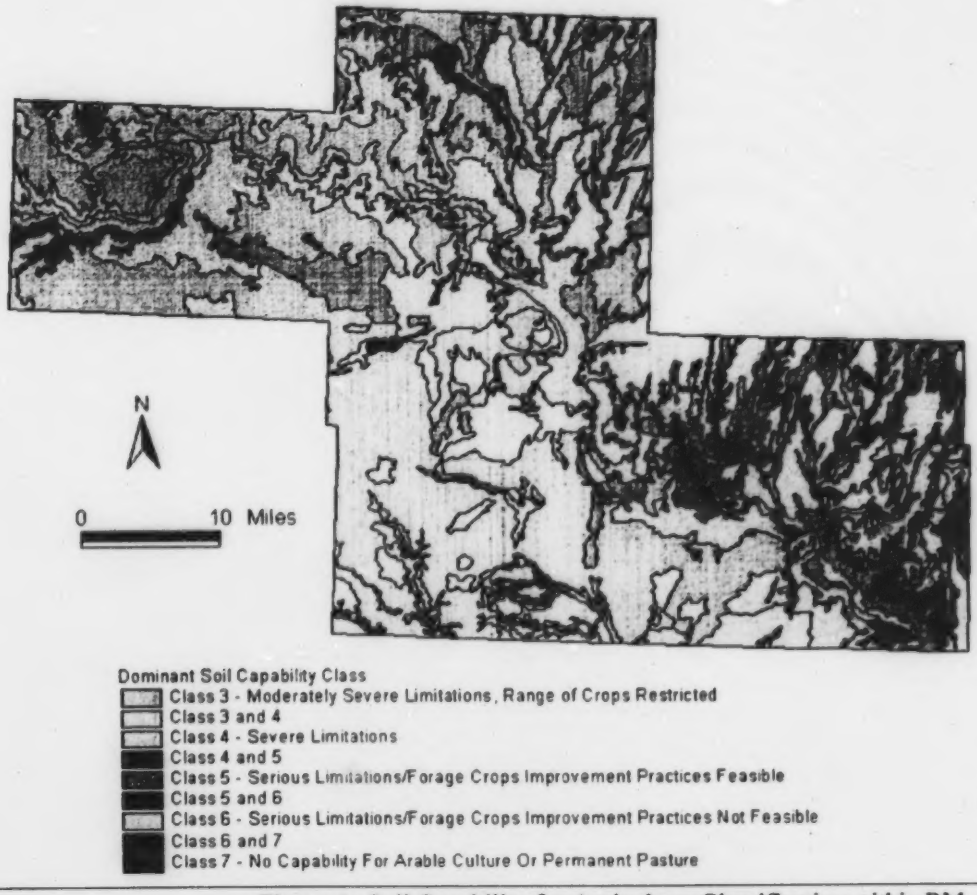

N
0
10 Miles
Dominant Soil Capability Class
Class 3 - Moderately Severe Limitations, Range of Crops Restricted
Class 3 and 4
Class 4 - Severe Limitations
Class 4 and 5
Class 5 - Serious Limitations/Forage Crops Improvement Practices Feasible
Class 5 and 6
Class 6 - Serious Limitations/Forage Crops Improvement Practices Not Feasible
Class 6 and 7
Class 7 - No Capability For Arable Culture Or Permanent Pasture

Figure 4. Soil Capability for Agriculture Classification within RM #17 - Val Marie (based on digital data derived from the 1:100,000 RM #17 digital soil data file)

Overlay Procedure

The overlay of the digital map data was done in Arc/Info using the GRID module, a raster or cell-based data storage and processing tool integrated in Arc/Info. Data processing was done in a raster format because the size of the SDLC data file made processing in a vector environment difficult. The seamless composite SDLC data file had already been converted from image (TIFF) into raster GRID format. The modified Atlas of Saskatchewan and 1:100,000 RM soil data were converted from ARC/INFO vector coverages to ARC/INFO raster-based grid files. All files were gridded to a cell size of 30 metres by 30 metres corresponding to the original SDLC pixel size.

All datasets were standardized to the following projection parameters:

Projection: Universal Transverse Mercator, zone 13
Units: meters
Datum: NAD83.

Analysis

The tabular results of the spatial analysis were downloaded from the Arc/Info GIS into spreadsheet software (Excel). The files provided information on the occurrence of native dominant grasslands with respect to soil capability classes. In some cases a "0" value was present where portions of the polygon were unclassified.

The results of the overlay of the SDLC Class 3 (Native Dominant Grasslands) digital data with the Atlas of Saskatchewan data covering the Prairie ecozone and RM #17 are provided in tabular form below in Tables 4 and 5, and in graphic form in Figures 5 and 6, respectively. The results of the SDLC data and 1:100,000 RM soils data overlay are provided in Table 6 and Figure 7. Appendix 3 provides the area in km2 of each SDLC class within the Prairie Ecozone. The totals for Class 3 – Native Dominant Grasslands and the Ecozone total was used to derive percentage of total Native Dominant Grasslands calculations and percentage calculations relative to the entire ecozone in Tables 4 through 6.

Inspection of the tabular and graphic results reveals some unexpected results. For example, Table 4 indicates that 8.73 km2 of native dominant grasslands occur in urban areas and 609.86 km2 occur in water bodies. The first seems high, while the second is impossible. Some reasons for the inclusion of the native dominant grasses in these features are: (1) Scale, (2) Data Format and (3) Date of Source Data.

The Atlas of Saskatchewan data file is a relatively coarse small scale file with a minimum scale of 1:1,000,000. Overlaying small scale data with larger scale data files will result in inconsistencies due to the generalization associated with the smaller scale data file. Regarding data format, both soil capability files were provided in vector format and then converted to raster format. Both would be subject to errors associated with this type of conversion which in turn could be responsible for some of the inconsistencies. Also, the Atlas data was based on a generalization of older Soil Landscapes of Canada (SLC) agriculture capability data. If the urban areas and water bodies were derived from the older source data, these features would be inconsistent with the more current base map information to which the SDLC data would be tied.

Table 4. Area in km2 and % of total area of Native Dominant Grasslands (NDG) by Soil Capability Class (based on Atlas of Saskatchewan digital data) within Saskatchewan's Prairie Ecozone

SOIL CLASS	SOIL CLASS DESCRIPTION	AREA KM2	% of total NDG	% of Ecozone
1	No Significant Limitations	231.08	0.45%	0.10%
2	Moderate Limitations/Moderate Conservation Practices	5072.21	9.82%	2.10%
3	Moderately Severe Limitations	7228.68	14.00%	3.00%
4	Severe Limitations	14758.05	28.58%	6.12%
5	Forage Crops Improvement Practices Feasible	12608.75	24.42%	5.23%
6	Forage Crops Improvement Practices Not Feasible	11124.62	21.54%	4.62%
urban	Urban Area	8.73	0.02%	0.00%
water	Water	609.86	1.18%	0.25%

51641.98 100.00% 21.43%

Saskatchewan Prairie Ecozone: 240965.14 KM2

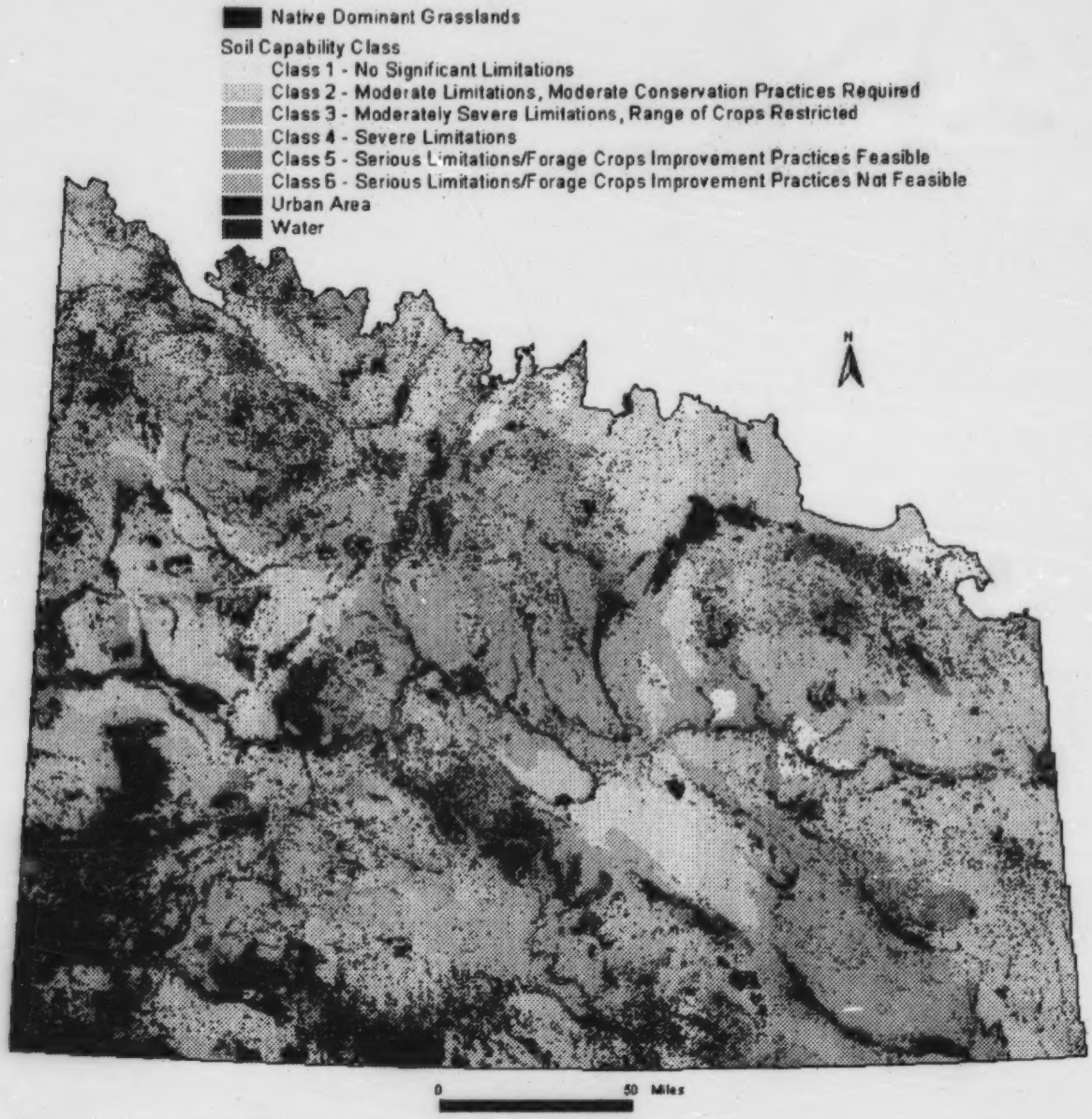

Native Dominant Grasslands
Soil Capability Class
Class 1 - No Significant Limitations
Class 2 - Moderate Limitations, Moderate Conservation Practices Required
Class 3 - Moderately Severe Limitations, Range of Crops Restricted
Class 4 - Severe Limitations
Class 5 - Serious Limitations/Forage Crops Improvement Practices Feasible
Class 6 - Serious Limitations/Forage Crops Improvement Practices Not Feasible
Urban Area
Water
N
0
50 Miles

Figure 5. The occurrence of Native Dominant Grasslands relative to Soil Capability for Agriculture Classification (based on digital data derived from the Atlas of Saskatchewan Digital Data Set, 1999) within Saskatchewan's Prairie Ecozone.

Table 5. Area in km2 and % of total area of Native Dominant Grasslands (NDG) by Soil Capability Class (based on digital data from the Atlas of Saskatchewan Digital Data Set, 1999) within RM #17 – Val Marie.

SOIL CLASS	SOIL CLASS DESCRIPTION	AREA KM2	% of total NDG	% of RM
3	Moderately Severe Limitations	6.89	0.37%	0.22%
4	Severe Limitations	673.39	36.36%	21.52%
5	Forage Crops Improvement Practices Feasible	566.98	30.61%	18.12%
6	Forage Crops Improvement Practices Not Feasible	604.80	32.66%	19.33%
		1852.05	**100.00%**	**59.18%**

Saskatchewan RM #017: 3129.272 KM2

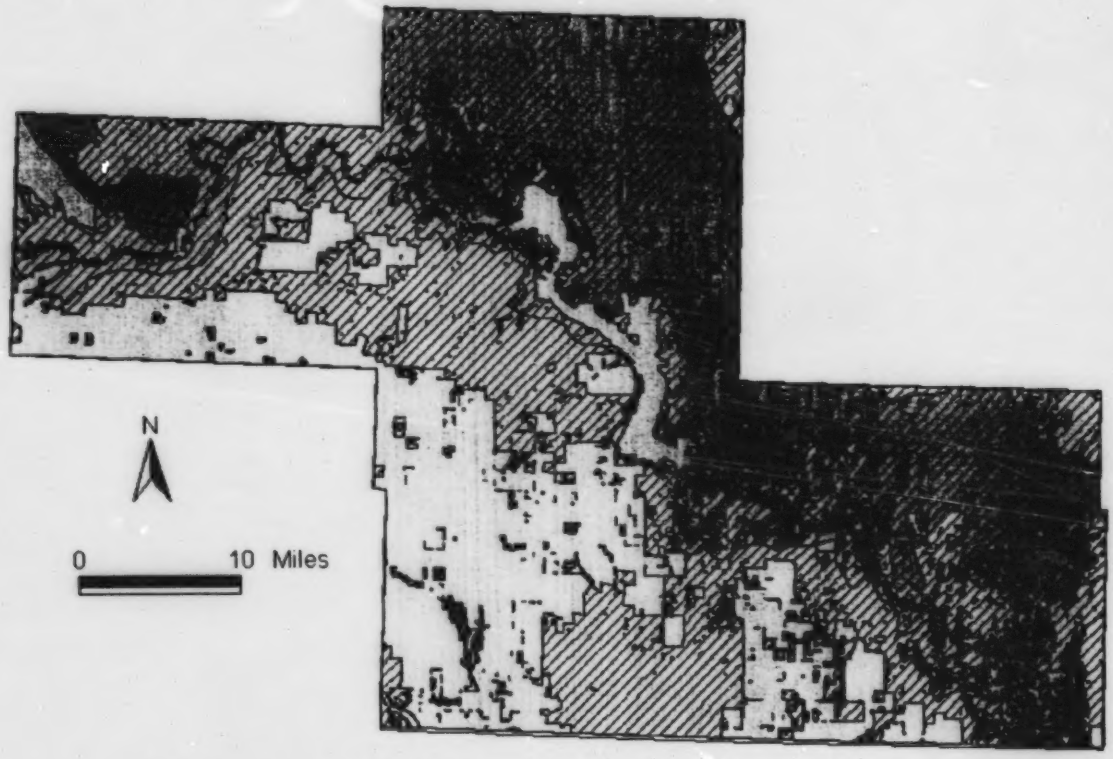

N
0
10 Miles
Native Dominant Grasslands
Soil Capability Class
Class 3 - Moderately Severe Limitations, Range of Crops Restricted
Class 4 - Severe Limitations
Class 5 - Serious Limitations/Forage Crops Improvement Practices Feasible
Class 6 - Serious Limitations/Forage Crops Improvement Practices Not Feasible

Figure 6. The occurrence of Native Dominant Grasslands relative to Soil Capability for Agriculture Classification (based on digital data derived from the Atlas of Saskatchewan Digital Data Set, 1999) within RM #17 – Val Marie.

Table 6. Area in km2 and % of total area of Native Dominant Grasslands (NDG) by Soil Capability Class (based on the digital 1:100,000 RM #17 soil data file) within Saskatchewan's RM #17 – Val Marie.

SOIL CLASS	SOIL CLASS DESCRIPTION	AREA KM2	% of total NDG	% of RM
0	Unclassified	1.00	0.05%	0.03%
3	Moderately Severe Limitations	463.18	25.01%	14.80%
4	Severe Limitations	589.30	31.82%	18.83%
5	Forage Crops Improvement Practices Feasible	310.14	16.74%	9.91%
6	Forage Crops Improvement Practices Not Feasible	382.53	20.65%	12.22%
7	No Capability For Arable Culture Of Permanent Pasture	35.54	1.92%	1.14%
3 & 4	Shared Dominance of Soil Capability Classes 3 and 4	51.58	2.78%	1.65%
4 & 5	Shared Dominance of Soil Capability Classes 4 and 5	6.49	0.35%	0.21%
5 & 6	Shared Dominance of Soil Capability Classes 5 and 6	11.93	0.64%	0.38%
6 & 7	Shared Dominance of Soil Capability Classes 6 and 7	0.50	0.03%	0.02%
		1852.19	**100.00%**	**59.19%**

Saskatchewan RM #017: 3129.272 KM2

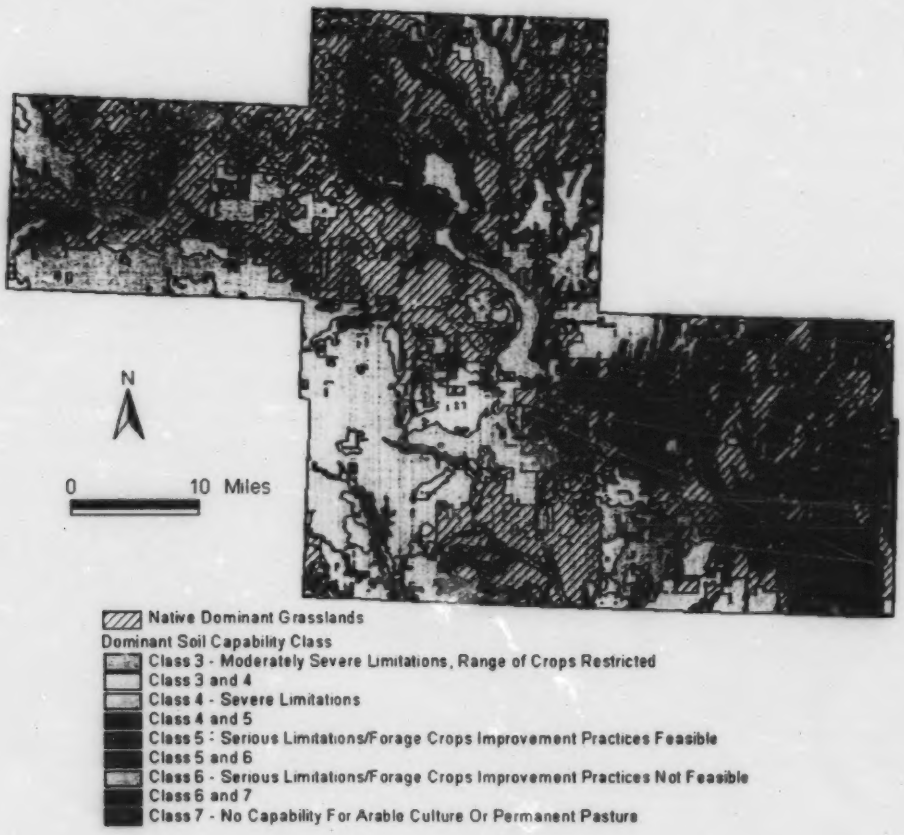

N
0
10 Miles
Native Dominant Grasslands
Dominant Soil Capability Class
Class 3 - Moderately Severe Limitations, Range of Crops Restricted
Class 3 and 4
Class 4 - Severe Limitations
Class 4 and 5
Class 5 : Serious Limitations/Forage Crops Improvement Practices Feasible
Class 5 and 6
Class 6 - Serious Limitations/Forage Crops Improvement Practices Not Feasible
Class 6 and 7
Class 7 - No Capability For Arable Culture Or Permanent Pasture

Figure 7. The occurrence of Native Dominant Grasslands relative to Soil Capability for Agriculture (based on digital data derived from the 1:100,000 RM #17 Soils data file) within RM #17 – Val Marie.

A comparison of the results for the two agriculture capability data files shows additional inconsistencies. Table 7 offers a comparison of the results of the native dominant grasslands overlay with soil capability data for both soils files for soil classes 3 to 6 (values for co-dominant classes in the 1:100,000 RM Soil file were not included). The greatest difference occurs in soils classed as having moderately severe limitations, with the Atlas data file containing 456 fewer km2 of dominant native grasslands than the 1:100,000 RM file.

Table 7. Comparison of Area in km2 and % of total area of Native Dominant Grasslands (NDG) by Soil Capability Class between the Atlas of Saskatchewan digital soil capability data and the 1:100,000 RM digital soil data covering RM #17.

SOIL CLASS	SOIL CLASS DESCRIPTION	Atlas RM 17 AREA KM2	Atlas RM 17 % Tot. NDG	1:100,000 RM 17 AREA KM2	1:100,000 RM 17 % Tot. NDG	Diff. AREA KM2	Diff. % Tot. NDG
3	Moderately Severe Limitations	6.89	0.37%	463.1769	25.01%	-456.29	-24.64%
4	Severe Limitations	673.39	36.36%	589.2984	31.82%	84.09	4.54%
5	Forage Crops Improvement Practices Feasible	566.98	30.61%	310.1418	16.74%	256.83	13.87%
6	Forage Crops Improvement Practices Not Feasible	604.80	32.66%	382.527	20.65%	222.27	12.00%

Significant differences are also evident in the visual depictions of each data file (refer to Figures 3 and 4, or 6 and 7). The RM data file offers a much more detailed differentiation among soil capability classes which are lost in the Atlas data file due to generalization. While the small scale Atlas of Saskatchewan soil capability data offers a general view of agriculture capability for the Prairie ecozone, the 1:100,000 RM Soils data provides a more detailed source where more accurate data interpretation is required.

Appendices

Appendix B Sub-Appendix 1 - Description on of Southern Digital Land Cover Classes

Class #	Type	Description
1	Crop Land	All lands dedicated to the production of annual cereal, oil seed and other specialty crops, and typically cultivated on an annual basis
2	Hay Crops - Forage	Alfalfa and alfalfa/tame grass mixtures
3	Native Dominant Grasslands	Native dominant grasslands/may contain tame grasses and herbs
4	Tall Shrubs	Communities containing both low and tall shrub, snowberry, saskatoon, chokecherry, buffaloberry, and willow
5	Pasture - Seeded Grasslands	Grasslands dominated by tame grass species
6	Hardwoods - Open Canopy	Corresponds to Provincial Forest Inventory: over 75% hardwoods; 10-30% crown closure
7	Hardwoods - Closed Canopy	Corresponds to Provincial Forest Inventory: over 75% hardwoods; 30-100% crown closure
8	Jack Pine - Closed Canopy	Similar to Provincial Forest Inventory: 75% or greater Jack Pine; 30-100% crown closure
9	Jack Pine - Open Canopy	Similar to Provincial Forest Inventory: 75% or greater Jack Pine; 10-30% crown closure
10	Spruce - Closed Canopy	Similar to Provincial Forest Inventory: 75% or greater Black and White Spruce; 10-30% crown closure
11	Spruce - Open Canopy	Similar to Provincial Forest Inventory: 75% or greater Black and White Spruce; 10-30% crown closure
12	Mixed Woods	All softwood/hardwood mixtures
13	Treed Rock	Areas of exposed bedrock with generally less then 10% tree cover. Dominant species are Jack Pine and Black Spruce.
14	Recent Burns	All areas that have been recently burned over by wildfires.
15	Revegetating Burns	Burns with a regrowth of commercial timber generally 1-5 metres in height.
16	Cutovers	Areas where commercial timber has been completely or partially removed by logging operations.
17	Water Bodies	Consists of all open water - lakes, rivers, streams, ponds and lagoons.
18	Marsh	Dominated by sedge and wetland grasses.

19	Herbaceous Fen	Fens dominated by herbaceous species.
20	Mud/Sand/Saline	
21	Shrub Fen - Treed Swamp	Fens dominated by shrubby species.
22	Treed Bog	Peat-covered or peat-filled depressions with a high water table and surface carpet of moss, chiefly sphagnum. The bogs have 25% or more canopy by trees greater than one metre tall. The primary species is Black Spruce.
23	Open Bog	Peat-covered or peat-filled depressions with a high water table and a surface carpet of moss, chiefly sphagnum.
24	Farmstead	Farmstead types, towns, cities, exposed areas with little or no vegetation, or cloud coverage.
25 & 26	Slopes	Steep valley slopes or hill slopes where aspect and slope prohibit classification.

Appendix B Sub-Appendix 2
Description of Soil Capability Classes and Subclasses.

The following descriptions have been taken from "A Guide to Soil Capability and Land Inventory Maps In Saskatchewan" (Second Edition, April 1968), Publication M8, Saskatchewan Institute of Pedology, University of Saskatchewan, Saskatoon, Saskatchewan, pages 2 –10.

SOIL CAPABILITY FOR AGRICULTURE

The Soil Capability Classification and Land Use Inventory of the Soils of Saskatchewan was initiated in 1963 as an A.R.D.A. Research Project under the direction of J.S. Clayton and the late W.L. Hutcheon. This project involved the preparation of maps for local distribution showing the Soil Association, textural type, capability classification and land use of the area within each Rural Municipality and Local Improvement District. These maps form the basis for the soil capability maps published by the Canada Land Inventory in Map Sheet Areas at a scale of 1 inch equals 4 miles.

Soil Capability Classification

The soil capability classification is one of a number of groupings which can be made from Soil Survey or Land Assessment data. It represents an interpretive classification of soils based on limitations affecting their agricultural use, and is supplemented by information concerning their general productive capacity for common field crops. The interpretations are based on existing information and have not involved any major degree of field inspection for this specific purpose.

The limitations for agricultural use are categorized acco17ding to their degree and their kind. The degree of limitation is represented by the capability class which forms the broadest category of the classification. The kind of limitation is represented by the capability subclass of which there are fourteen in all. The capability class level is, therefore, determined by the degree of limitation imposed by a particular capability subclass.

Capability Class - Degree of Limitation

The mineral soils of Saskatchewan are grouped into seven capability classes (Table 1). Soils within Classes I, 2 and 3 are considered suitable for the sustained production of common field crops; Class 4 soils are physically marginal for the sustained production of field crops; Class 5 soils are suited only to permanent pasture where improvement practices are feasible; Class 6 soils are suited only to native pasture where improvement practices are not feasible; and Class 7 soils are unsuitable for either field crops or permanent pasture.

Some of the important factors on which the classification is based are outlined below:

1. The soils will be managed and cropped under a largely mechanized system.

2. Distance to market, kind of roads, location, size of farm, characteristics of land ownership, cultural patterns and the skill or resources of individual

operators and hazard of crop damage by storms are not criteria for capability groupings.

3. Soils considered feasible for improvement by practices that can be made economically by the farmer himself are classified according to their limitations after the improvements are made. Land requiring improvement beyond the means of the individual farmer is classed according to its present condition.

4. The soil capability classification has been applied to virgin as well as cultivated areas. However, it has not been applied to National or Provincial Parks, Provincial Forest or other areas which have not been covered by reconnaissance soil surveys.

Soil Capability Classes - Degree of Limitation

CLASS 1: SOILS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS THAT RESTRICT THEIR USE FOR CROPS.

Class 1 soils have level or gently sloping topography, they are deep, well to moderately drained and have good water-holding capacity. These soils are naturally well supplied with plant nutrients and also respond well to additional inputs of fertilizer. They are easily maintained in good tilth and fertility. Erosion damage (wind and water) is low. They are moderately high to high in productivity for a wide range of field crops. In terms of wheat, they may be expected to give average yields of 20-25 bushels per acre with an estimated potential average yield of 30-35 bushels per acre (7). They occur in areas having no significant climatic limitations for soil management and use within the Prairie Region and are mainly confined to the medium to moderately fine textured soils of the Thick Black and Dark Gray soil zones and to the moderately fine textured soils of the Black soil zone.

CLASS 2: SOILS IN THIS CLASS HAVE MODERATE LIMITATIONS THAT REDUCE THE CHOICE OF CROPS OR REQUIRE MODERATE CONSERVATION PRACTICES.

Class 2 soils require careful soil management including conservation practices to prevent soil deterioration or to improve air and water relationships when the soils are cultivated. The limitations are not severe and the practices are easy to apply.

Soils in this class have good water-holding capacity and are either well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderately high to high in productivity for a fairly wide range of crops. Average wheat yields are 15.5-20 bushels per acre and their estimated potential average yield is 24-30 bushels per acre (7). With favourable years and application of good tillage, management, and moisture conservation practices, these soils will frequently compare in productivity to Class 1 soils.

In the Thin Black soil zone, soils of loam texture are considered as Class 2 because of insufficient moisture-holding capacity. The clay and heavy clay soils occurring in the Dark Brown soil zone and the heavy clay soils in the Brown

soil zone are also considered as Class 2 soils, their only limitation being due to insufficient precipitation.

CLASS 3: SOILS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS THAT REDUCE THE CHOICE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES.

Class 3 soils have more severe limitations than those in Class 2 and conservation practices are usually more difficult to apply and maintain. Limitations adversely affect the timing and ease of tillage, planting and harvesting, the choice of crops, the application of conservation practices, or some combination of these limitations.

Soils in this class are medium to moderately high in productivity for a moderate range of crops. In terms of wheat, their average yield ranges from 11.0-15.5 bushels per acre, and the estimated potential average yield is 19-24 bushels per acre (7). Even with good management practices, Class 3 soils in the Brown and Dark Brown soil zones show wide variability in yields due to the variations in climatic conditions.

In the Brown soil zone, Class 3 soils include those with higher than average moisture storage capacities (clay loam or clay textures) and in the Dark Brown soil zone their textures range from very fine sandy loam to clay loam. They also include Gray Wooded soils with inferior structural characteristics.

CLASS 4: SOILS IN THIS CLASS HAVE SEVERE LIMITATIONS THAT RESTRICT THE CHOICE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES OR BOTH.

Class 4 soils have such limitations that they are suited only for a few crops, or the yield for a range of crops may be low, or the risk of crop failure is high.

Class 4 soils are low to medium in productivity for a narrow range of crops but may have higher productivity for a special crop. Average wheat yields range from 9.0-11.0 bushels per acre with a high incidence of variability. The estimated potential average yield of these soils is 13-15 bushels per acre (7).

Class 4 soils in Saskatchewan include most of the sandy soils of low moisture storage capacity in the Dark Brown, Black and Dark Gray soil zones, and those of loam or coarser texture in the Brown soil zone. They also include all soils on moderately rolling and strongly sloping topography and local soils of low inherent fertility and those with a significant incidence of alkalinity, or poor structure and physical conditions. The high incidence of low crop yields or disastrous failures throughout their cropping history suggests that some of these soils should be removed from continued use for grain production.

CLASS 5: SOILS IN THIS CLASS ARE CAPABLE ONLY OF PRODUCING PERENNIAL FORAGE CROPS AND IMPROVEMENT PRACTICES ARE FEASIBLE.

Class 5 soils have serious soil or landscape limitations which make them unsuited for the production of annual cultivated field crops. However, they may be improved by the use of farm machinery for the production of native or tame species of perennial forage crops. Feasible improvement practices may include

clearing of bush, cultivation, seeding to perennial forage crops, fertilizing, herbicide application and water control. The productivity of these soils for improved or native pasture is moderately high to high (1).
Most pasture land throughout the province may be considered as Class 5 lands except those on coarse textured soils in the drier portions of the Brown soil zone, or where exceptionally steep or excessively arid slopes make improvement practices unfeasible.

CLASS 6: SOILS IN THIS CLASS ARE CAPABLE ONLY OF PRODUCING NATIVE PERENNIAL FORAGE PLANTS AND IMPROVEMENT PRACTICES ARE NOT FEASIBLE.
Class 6 soils have some natural sustained grazing capacity for farm animals but have such serious soil or landscape limitations as to make impractical the application of improvement practices which can be carried out on Class 5 soils.

Soil areas may be placed in this class because their physical nature prevents the use of farm machinery to improve them, or because the soils are not responsive to improvement practices, or because of a short grazing season, or because stock watering facilities are inadequate. Improvement practices which may be effected by seeding and fertilizing by hand or by aerial methods, will not change the classification of these soil areas. These soils have low to moderate productivity for unimprovable native pasture (1). These lands include exceptionally rough upland pasture and meadow areas generally too wet to be utilized for hay but which provide some native grazing for livestock. Where costly clearing is required to change Class 7 areas to Class 6 areas, those areas will remain as Class 7.

CLASS 7: SOIL AND LANDS IN THIS CLASS HAVE NO CAPABILITY FOR ARABLE AGRICULTURE OR PERMANENT PASTURE.
Land areas not included in Classes 1 to 6 or classified as Organic Soils shall be placed in this class. It will include bodies of water too small to delineate on maps, townsites, parks, airports, railroads, roads and lands used by industry.
ORGANIC SOILS: Unimproved or virgin organic soils including muskeg and peat are not included in Classes 1 to 7, but are designated by the letter 0.

The characteristics of the capability classes are summarized in Table 1. It should be emphasized that the soils within a capability class are similar only with respect to degree, but not to kind of limitation. Each class may include many different kinds of soil and many of the soils within any one class may require unlike management and treatment. It is also important to note that while the soil areas in Classes 1 to 4 are suited for cultivated crops, they are also suited for perennial forage crops. Soil areas in all classes may also be suited for forestry, wildlife or recreation.

It is realized that soil capability classes based on limitations for use, are not necessarily synonymous with classes based solely on productivity, if such a classification were available. Nevertheless, in an area such as Saskatchewan, it is generally considered that the limiting effect of climate and associated moisture relationships tend to govern productivity.

TABLE 1. SUMMARY OF THE GUIDING CRITERIA FOR CAPABILITY CLASSES IN SASKATCHEWAN

Class	Degree of Limitations	Range of Adaptability	Productivity
1	No significant limitations.	Wide range of field crops.	Moderately high to high, 20-25 bu/acre (30-35 bu/acre)**
2	Moderate limitations due to climate, soil or landscape.	Fairly wide range of field crops.	Moderately high to high, 15.5-20 bu/acre* (24 to 30 bu/acre)**
3	Moderately severe limitations due to climate, soil or landscape.	Moderate range of field crops.	Medium to moderately high, 11-15.5 bu/acre (19-24 bu/acre)**
4	Severe limitations due to climate, soil or landscape.	Physically marginal for field crops.	Low to medium, 9~11 bu/acre * (13-j-5 hJ acre)
5	Serious soil or landscape limitations make them unsuitable for the production of annual crops.	Suited for the production of adapted grasses and legumes or improved pasture.	Moderately high to high.
6	Very serious soil or landscape Limitations restrict their use to native grazing.	Suited only to native pasture.	Low to moderate.
7	Prevent agricultural use.	Unsuited for agricultural use.	Non productive.

*, ** Productivity of arable Classes 1-4 is expressed in terms of long-time (1932-1961) average wheat yields in bu/acre and estimated potential average productivity, respectively.

Soil Capability Subclasses - Kinds of Limitation

The capability subclass represents a grouping of soils which have the same kind of limitation for agricultural use. Each subclass limitation is represented by an appropriate symbol (see page 10) which is written immediately behind the capability class number except in the case of Class 1 soils which do not have any significant limitations. For example, 3m represents a soil area rated as Class 3 due to insufficient moisture-holding capacity (m). It is not practical to show more than two subclasses for each capability class and they are listed in order of their importance.

Fourteen different kinds of limitations are recognized as a result of the climate, the soil, or the landscape, evaluated in that order. The limiting effects of climate are considered first as they affect the initial capability class of soils on a broad subregional basis. These are followed by the limitations characteristic of the Soil Association and textural types within a subregion. Limitations imposed by the local landscape complete the evaluation. The subclass limitations are outlined below:

CAPABILITY SUBCLASSES - KIND OF LIMITATLONS

Climatic limitations:	expressed on the basis of adverse subregional climate where there are no other limitations except climate.
SUBCLASS Cm:	moisture deficiency due to insufficient precipitation.
SUBCLASS Cs:	heat deficiency expressed in terms of length of growing season and frost-free period.
Soil limitations:	caused by unfavorable inherent soil characteristics.
SUBCLASS m:	insufficient soil moisture-holding capacity.
SUBCLASS d:	poor structure and/or permeability.
SUBCLASS f:	low inherent soil fertility.
SUBCLASS n:	excessive soil salinity.
SUBCLASS s:	unfavorable soil characteristics. This subclass is used in a collective sense in place of subclasses m, d, f, and n where more than two of them are present or where two of these limitations are present in addition to some other limitation.
Landscape limitations.	
SUBCLASS t:	unfavorable topography.
SUBCLASS w:	excess water - applies to soils where excess water, apart from that brought about by inundation is a limitation in their use for agriculture.
SUBCLASS p:	excess stoniness.
SUBCLASS e:	erosion damage.
SUBCLASS i:	inundation - applies to soils subjected to flooding due to overflow.
SUBCLASS r:	shallowness to bedrock.
SUBCLASS x:	moderate limitation due to accumulative minor adverse characteristics which singly are not serious enough to affect the class rating.

Appendix B Sub-Appendix 3

Area in km^2 and percentage of each SDLC (Southern Digital Land Cover) within the Prairie Ecozone of Saskatchewan.

		PRAIRIE ECOZONE	
SDLC Classes & Codes		km2	%
0	Unclassified	188.93	0.1%
1	Crop Land	158691.05	65.9%
2	Hay Crops - Forage	2827.54	1.2%
3	**Native Dominant Grasslands**	**51642.41**	**21.4%**
4	Tall Shrubs	6357.49	2.6%
5	Pasture - Seeded Grasslands	2231.51	0.9%
6	Hardwoods - Open Canopy	4038.60	1.7%
7	Hardwoods - Closed Canopy	678.33	0.3%
8	Jack Pine - Closed Canopy	22.71	0.0%
9	Jack Pine - Open Canopy	1.64	0.0%
10	Spruce - Closed Canopy	0.41	0.0%
11	Spruce - Open Canopy	0.54	0.0%
12	Mixed Woods	21.97	0.0%
13	Treed Rock	0.00	0.0%
14	Recent Burns	0.00	0.0%
15	Revegetating Burns	0.00	0.0%
16	Cutovers	0.00	0.0%
17	Water Bodies	5359.09	2.2%
18	Marsh	5008.38	2.1%
19	Herbaceous Fen	306.64	0.1%
20	Mud/Sand/Saline	1465.97	0.6%
21	Shrub Fen - Treed Swamp	0.03	0.0%
22	Treed Bog	2.02	0.0%
23	Open Bog	0.00	0.0%
24	Farmstead	1960.34	0.8%
25	Slopes	0.10	0.0%
26	Slopes	159.44	0.1%
TOTALS		**240965.14**	***100.0%***

Appendix 'C' – Overlay of Southern Saskatchewan Digital Land Cover Class #3 – Native Dominant Grasslands with PFRA Community Pasture and Saskatchewan Agriculture and Food Native Prairie Crown Land.

OBJECTIVE

This report with the overlay and analysis of (a) Saskatchewan Agriculture and Food (SAF) Native Prairie Crown land and (2) PFRA community pastures relative to Saskatchewan Southern Digital Land Cover (SDLC) Native Dominant Grasslands land cover type. In both cases the analysis covered the entire Prairie ecozone (see Figure 1 below) and was conducted to the ecoregion level.

The overlay and analysis of SAAF Native Paine Crown land relative to the SDLC data is an extension to the original requirements of the Native Prairie Mapping Project (ADF Project # 19990285). Upon review of the third project milestone report, technical reviewers with the Agriculture Development Fund (ADF) recommended additional analysis. One reason for the additional work was to improve differentiation between crown and non-crown native prairie.

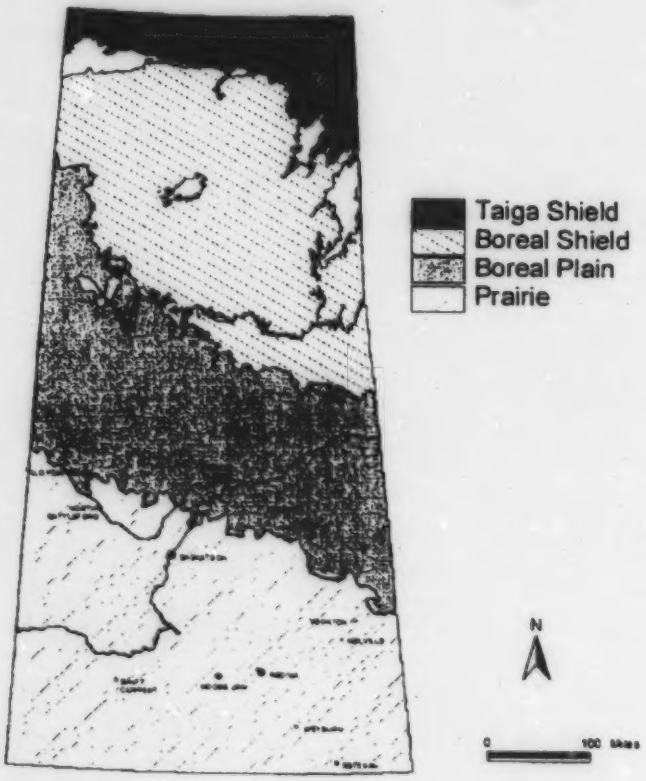


Figure 1 Ecozones of Saskatchewan

METHODOLOGY

A description of the three data files used during this phase of the Native Prairie Mapping project is provided below, followed by a brief description of the overlay procedures.

Southern Digital Land Cover (SDLC) 1994 Digital Data File. The SDLC is a digital file comprising 335 1:50,000 digital land cover map sheets produced by the Saskatchewan Research Council (SRC) as part of the Southern Digital Land Cover Project for Saskatchewan. The land cover data files display 26 possible land cover classes, which have been derived through satellite image analysis
PFRA provided a seamless composite TIFF image of the 335 original 1:50,000 digital land covermap sheets. The file was provided in TIFF format, Universal Transverse Mercator extended zone13 projection, and datum NAD83. Each pixel represents an area of3O metres by 30 metres.

The SDLC file had been converted from TIFF format to Arc/Info's GRID format during the previous phase of the Native Prairie Mapping project. During this phase the only modification made to the SDLC coverage before it could be used for overlay analysis with the digital soil capability data was the extraction of the Native Dominant Grasslands class within the Prairie ecozone for all four prairie ecoregions.

PFRA Digital Community Pasture Data. This data file contains polygons in an Arc/Info vector format representing community pastures throughout Saskatchewan. The PFRA Community Pastures 615 unit provided this layer in 1995.The community pasture boundaries were originally obtained from aerial photography and later convened into a digital polygon coverage.

Saskatchewan Agriculture and Food (SA F) Crown Land Database SAF provided a digital .dbf IV file containing 37452 records derived from the SAF Crown Land database showing the area in acres of native and wasteland by quarter section. While the number of acres by land type (native or waste) for each quarter section was provided, the exact location of native and wasteland within the quarter section is not known.

Each record in the digital database file was referenced to a PPID. This allowed the data to be linked to the digital township fabric data file. Some modifications to the original file were necessary in order to link the database information to the digital township fabric data file. In some cases, up to four records were labelled with the same PPID. Where more than one record representing the same PPID was found, the acre values were merged (summed) into one unique PPID per record.

The breakdown of multiple records labelled with the same PPID is as follows:
Records with a frequency of 2 = 2167
Records with a frequency of 3 = 31
Records with a frequency of 4 = 1

The overlay procedure was done in a vector environment. First, the Native Dominant Grasslands layer was extracted from the SDLC data set by ecoregion. The four ecoregion

Appendix 'C' –Sub-Appendix 1
Saskatchewan Prairie Ecozone Intersection of Saskatchewan Agriculture and Food (SAF) Crown Land Classified as 100% Native Prairie with Native Dominant Grasslands from the Southern Digital Land Cover (SDLC) Data Set

SASKATCHEWAN PRAIRIE ECOZONE
Intersection of Saskatchewan Agriculture and Food (SAF) Crown Land Classified as 100% Native Prairie with Native Dominant Grassland From the Southern Digital Land Cover (SDLC) Data Set
100% Native Prairie SAF Crown Land coincident with SDLC Native Dominant Grassland *
100% Native Prairie SAF Crown Land not coincident with SDLC Native Dominant Grassland *
Prairie Ecoregions
Aspen Parkland
Moist Mixed Grasslands
Mixed Grasslands
Cypress Uplands
SASKATOON
REGINA
MOOSE JAW
ESTEVAN
N
0
Kilometers
* The SAF Crown Land database records the number of acres of native prairie within each quarter section. Only quarter sections containing 160 acres (or 100%) native prairie were used in the analyses depicted above.

files containing Native Dominant Grasslands were convened from raster format to vector format. Each of the four ecoregion files were intersected with the Crown Land data and then with the PFRA community pasture data file. In the case of the Crown Land data overlay, only quarter sections containing100% (or 160 acres) of native prairie were considered. This included approximately 35% of the quarter sections containing SAF native prairie. The results of the intersections are provided in Tables 1 and 2 below. The graphic depiction of the results is provided in Appendices 1 and 2.

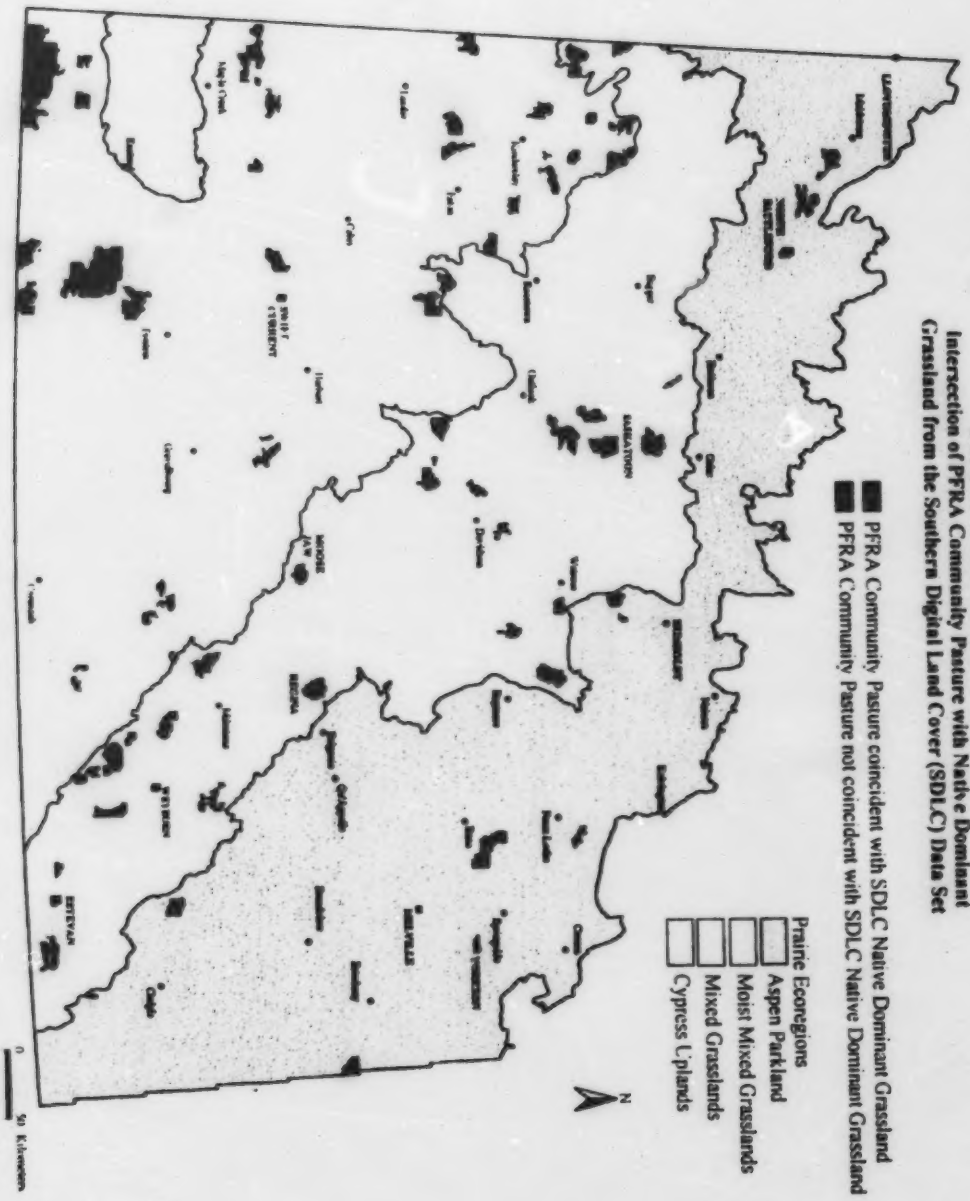
Table 1. Coincidence of Saskatchewan Agriculture and Food (SAF) Crown Land that is 100%Native Prairie with Southern Digital Land Cover (SDLC) Native Dominant Grasslands (NDG) by Ecoregion within the Prairie Ecoregion of Saskatchewan. ¶

Ecoregion	Total SAF Native Prairie (km2)	SAF Native Prairie coincident w/SDLC NDG		SAF Native Prairie not coincident w/SDLC NDG	
		Area (km2)	% of total	Area (km2)	% of total
Aspen Parkland	501	238	47.5	263	52.5
Mixed Grassland	5279	4694	88.9	545	11.1
Moist Mixed Grassland	540	415	76.9	125	23.1
Cypress Upland	1077	1014	94.1	63	5.9
Ecozone Totals	7397	6361	86.0	1036	14.0

Table 2. Coincidence of PFRA Community Pastures with Southern Digital Land Cover (SDLC)Native Dominant Grasslands b Ecoregion within the Prairie Ecoregion of Saskatchewan.

Ecoregion	Total PFRA Community Pasture (km2)	PFRA Community Pasture coincident w/SDLC NDG		PFRA Community Pasture not coincident w/SDLC NDG	
		Area (km2)	% of total	Area (km2)	% of total
Aspen Parkland	699	395	56.5	304	43.5
Mixed Grassland	3915	3553	90.8	362	9.2
Moist Mixed Grassland	1984	1529	77.1	455	22.9
Cypress Upland	0	0	0.0	0	0.0
Ecozone Totals	6598	5477	83.0	1120	17.0

Appendix 'C' –Sub-Appendix 2
Saskatchewan Prairie Ecozone Intersection of PFRA Community Pasture with Native Dominant Grasslands from the Southern Digital Land Cover (SDLC) Data Set


SASKATCHEWAN PRAIRIE ECOZONE
Intersection of PFRA Community Pasture with Native Dominant Grassland from the Southern Digital Land Cover (SDLC) Data Set
PFRA Community Pasture coincident with SDLC Native Dominant Grassland
PFRA Community Pasture not coincident with SDLC Native Dominant Grassland
Prairie Ecoregions
Aspen Parkland
Moist Mixed Grasslands
Mixed Grasslands
Cypress Uplands
N
0
50 Kilometers

Appendix 'D' – Text version of the publication "Saskatchewan's Native Prairie: Taking Stock of a Vanishing Ecosystem and Dwindling Resource".

Saskatchewan's Native Prairie:
Taking Stock Of A Vanishing Ecosystem And Dwindling Resource

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Introduction

The Canadian prairie offers a distinct environment for plants, animals and people who live here. A climate of long, cold winters and short, often dry summers challenges all creatures. Early indigenous people relied on an array of plants and animals for their survival. European explorers found a vast landscape, and some saw a barren land with little potential. Others described a land of opportunity. It was a land settled by only the most determined people from a variety of cultures. The prairies, once scoured by ice, were scoured again by iron. Today it is a land that has become globally recognized for production of high quality grains and meat. In the short history of European settlement, we have had a wide and profound impact on the land, an impact that many believe is irreversible.

This booklet is intended to provide an appreciation for the impact that settlement has had on Saskatchewan's prairie landscape. It is not intended to cast blame toward any sector of the population. Rather, it is to recognize that the prairie is an endangered ecosystem and as a part of our heritage it should be conserved.

What is Native Prairie?

The Saskatchewan prairies began to form 17,000 years ago as the last of the ice from the Wisconsin Glaciation melted. The soil types and landforms left in the wake of the glaciers, along with a harsh climate and disturbances resulting from periodic fires and grazing animals, created a unique environment. Over thousands of years, the prairie landscape evolved to include a wide variety of plant and animal species adapted to these environmental conditions. The open grassland interspersed with lakes, ponds, creeks, river valleys, shrubs and trees supported indigenous peoples and wildlife including, huge herds of grazing animals and a myriad of birds and insects. These age-old plant communities dominated by grasses are what we refer to as *native prairie*.

The southern half of Saskatchewan, previously covered by native prairie, is part of the *Prairie Ecozone* in Canada. Based on climate and landforms, the Prairie Ecozone is split into four *ecoregions*: Parkland, Moist Mixed Grassland, Mixed Grassland and Cypress Upland. The ecoregions are further subdivided into *landscape areas* based on distinct groupings of different physical features on the land, surface geology, soil, vegetation, water bodies and dominant land uses.

Grasses dominate native prairie, but a close look at the prairie uncovers hundreds of different species of grasses and wildflowers. It is incredibly diverse! In addition to open grassland, we see wetlands, saline land, shrubs, bluffs and even forested tracts. Each of these communities contains different plant communities, each providing unique habitat for wildlife.

Wisconsin Glaciation (or Wisconsin glacial stage) – is the name given to the period of time ranging from approximately 75,000 years ago to 17,000 years ago when most of Canada (east of the rockies) and part of the northern U.S.A. were covered by the Laurentide Ice Sheet. The ice was more than 1,000 m thick in some places! Because of their high elevation compared with the surrounding prairie, the Cypress Hills were never glaciated making them a unique land area in Saskatchewan.

With a change in climate the ice sheet started to melt faster than it could advance. This is called glacial retreat because the edge of the glacier melted fastest making it seem like it was moving backwards to the north. The retreat, however, took thousands of years. Deglaciation of

Saskatchewan took several thousand years starting about 10,000 years ago in the southern end of the province.

The glacier left behind many features of the landscape we say today. For example, large flat areas with clayey soil, like the Regina Plains, were once a glacial lake. Much of the province's soil formed on glacial till. This is a mix of stones, gravel, sand, silt and clay that was deposited by the glacier as it melted but without any sorting by water or wind.

As the glacier retreated, plants and animals occupied the newly deposited earth. While some plants and animals moved north from the now southern U.S.A, others spread south and east from Asia, across the Bearing Straight northwest of Alaska. This gave rise to two major groups of plants. Cool-season plants, coming from the north, tolerate cooler climates and dominated most of Saskatchewan's native prairie. Warm-season plants, coming from the south, are less dominant in Saskatchewan but replace the cool-season plants as you go south.

A Part Of Our Culture And Heritage

Our beliefs, habits, arts and lifestyle are strongly influenced by the environment we live in. Living on native prairie influenced the culture of First Nations and Metis people. Native plants and animals were used for food, medicine, ceremonies, art, tools and weapons. For European settlers, the native prairie provided fertile soil and offered a means of providing shelter (e.g., sod houses), a source of food and the foundation for an agricultural lifestyle. The ranching lifestyle is intimately connected with the open rangeland found only on the prairie. In the future, we will be looking to this land as a source of food, medicine, recreation, genetic resource, habitat for wildlife and as a benchmark of our past environment.

Native prairie is part of our heritage, *something that a person has as a result of having been born in a certain time or place.* We are quickly forgetting our connection with the land. Old-time farmers reminisce about the crocuses that grew on the hill down by the creek, the wild onions they ate to irritate the refined nose of their school teacher and the times they spent watching the burrowing owl seemingly turn its head in complete circles. It is rare now to find a piece of unbroken prairie large enough to show no evidence of European settlement. How can present and future generations appreciate the character of endless rolling grasslands and the challenges faced by First Nations people and settlers when this environment no longer exists? Will their native prairie experience be restricted to books herbaria, parks, zoos or their imagination?

A Threatened Ecosystem

In the last 150 years, the majority of native prairie in North America has disappeared. In Saskatchewan, it is estimated that almost 80% of the prairie has been lost. In local areas of prime cropland, less than 2% of the original prairie remains. What little prairie remains exists under quite different conditions than it had for thousands of years. The most obvious changes are the fragmentation of native habitat caused by road building, resource extraction, residential development and cultivation. Less obvious changes that threaten the prairie are the disappearance of prairie fires and the once massive herds of bison, the arrival of new and aggressive introduced (i.e., exotic) plants that displace native species, long-term overgrazing by cattle in some areas, and in others, a total lack of grazing. Periodic fire and grazing followed by rest rejuvenated the land and resulted in a landscape diverse in native plants. Now, lack of grazing and fire or continuous grazing without rest

has lowered the diversity of plant communities and life they support. Invasive exotic plants include Smooth Brome, Kentucky Bluegrass, Quack Grass, Crested Wheatgrass, Leafy Spurge and Purple Loosestrife. Even native shrubs and trees pose a threat when they expand into grasslands beyond their historical extent.

Definitions	
Fragmentation	The breaking of native prairie into smaller pieces, leaving islands of native prairie surrounded by cultivated land or seeded pastures.
Native plants (prairie)	Plants found naturally in a region before European settlement.
Exotic or introduced	Plants (and other organisms) brought to Saskatchewan during or following European settlement. Some of these plants are of particular concern because they are 'aggressive', they tend to invade native prairie easily and replace native plants.
Biodiversity	Best described as the "variety of life" including i) different patches on the landscape that host different plants and animals, ii) the number of different plants and animals living in a patch and iii) the different genetic varieties of the same plant or animal that allows it to grow in different environments.
Saline Land	There are different kinds of salt naturally present in the soil. Some of these salts dissolve very easily in water and are washed into the groundwater and collects in low-lying areas such as saline lakes. Too much salt makes it difficult for most plants to absorb water from the soil, leaving only a few that can survive these harsh conditions.
Idling	Leaving the land idle and in many cases unmanaged. Aside from grazing by wildlife, the land is not grazed, mowed, burned, cultivated, etc.
Overgrazing	Grazing land often or continuously during the growing season each year does not provide time for plants to recover. As a result, roots become shorter, plants become less productive, weeds are more likely to invade and the plants become more susceptible to drought.
Litter	Dead leaves and stems accumulating on grassland that is not overgrazed or burned. An even but not thick good cover of litter helps keep the soil moist, however, too much litter, such as that found on idled land, can prevent some plants from establishing and reduce biodiversity.

Why Is It Important To Know How Much Prairie Is Left?

The prairie region of Saskatchewan is one of the most widely disturbed areas of the world. The disappearance of native prairie means the disappearance of thousands of years of evolutionary history. This ecosystem can never be replaced. The prairie vegetation is vital to the survival of countless wildlife species, many of which have already dropped significantly in number or disappeared.

Native prairie is also a part of our culture and heritage, providing many benefits to its human inhabitants. These benefits include clean water, rangeland for livestock, aesthetic and recreational opportunities, soil protection and a gene pool available for future medical, agricultural and industrial uses. Native prairie is home to hundreds of plants and animals. This biodiversity or the "variety of life" is not only beautiful but can be used as an indicator of how healthy the ecosystem is.

Native Prairie: Benefits and Opportunities	
Culture and Heritage	Native prairie has shaped our lives. It has provided food, tools, construction materials, recreation, inspiration and a way of life. To lose the native prairie would be to lose a vital part of the history of our province.
Biodiversity	Native prairie is home to hundreds of plants and animals. A diverse ecosystem is more effective in capturing energy from the sun and cycling nutrients in the soil. It is also less susceptible to disturbances and stresses such as drought, disease and grazing. A diverse plant community becomes home to a much more diverse group animals than a community where only a few plants grow. By losing this diversity we threaten the integrity of the ecosystem we live in.
Recreation	Native prairie offers many recreational opportunities ranging from hunting to artwork. The wide-open spaces of native prairie attract tourists from around the world.
Future Resource	As it has in the past, native prairie offers bountiful opportunities for economical development. Wildlife, including native plants, will become an important genetic resource for developing new foods, medicines and fuels.
Ranching	Healthy native prairie is the foundation for the ranching lifestyle. Healthy grasslands produce livestock that are the envy of producers around the world.
A Benchmark	Representative areas of native prairie can be used to measure how we are changing our environment.
Educational Resource	Native prairie helps us learn about the environment we live in and the other organisms that we share it with.
Aesthetic Value	The beauty of the prairie is unrivalled. The open grassland, living sky and hidden valleys command a sense of place like no other.

Until recently, the extent of disturbance had not been measured. To help land managers develop better plans for its wise use, it is important to know how much prairie remains and where it is located.

How Is The Amount Of Native Prairie Measured?

Grassland, trees, shrubs, water, crops and roads all reflect light in a slightly different way, just like the different shades on a picture. These differences in reflectance are recorded on satellite images. Researchers used satellite images to estimate the area of different 26 land cover classes in the 4 ecoregions of the Prairie Ecozone. This method is much faster and easier than driving across the whole province and checking every piece of land.

The 26 cover classes were grouped to form six cover types: Native Dominant Grassland, Cropland & Seeded Pasture, Trees & Shrubs, Water & Wetlands and Other (Table 2). Here we are most interested in **Native Dominant Grassland** (i.e., native grassland), grassland dominated by native plants but possibly including some tame grasses and forbs (e.g., Smooth Brome and Alfalfa).

Determining land uses from satellite imagery is not an exact science. In some cases, different land uses may have a very similar reflectance. Tame pastures and hay crops, for example, are sometimes confused with native grassland. Using satellite imagery, some researchers have estimated that approximately 21% of the Prairie Ecozone remains as native grassland. Other researchers have suggested that as little as 17% of native grassland remains. This implies a considerable amount of error in using the satellite data. Another problem is that the data is only representative of the time the images were taken. Despite a variety of conservation efforts, we know that more and more native grassland is being disturbed.

Despite its limitations, satellite imagery still offers a good but general picture of land cover classes in the province. The information presented in this fact sheet is based on Southern Digital Land Cover (SDLC) 1994 Digital Data Files (cover class data was provided by the Prairie Farm Rehabilitation Administration). The maps provided here are very general. Much more site-specific maps can be produced from this information.

Our Remaining Prairie Resource

The Prairie Ecozone is estimated to include nearly 241,000 km^2 of land. **Only 21% of Prairie Ecozone is classified as Native Dominant Grassland as compared with 68% classified as Cropland** (Map 1, Table 1).

Approximately 20% of Saskatchewan's native grassland occurs in the **Aspen Parkland** ecoregion. Within this ecoregion, however, native grassland occupies only 13% of the landscape; over 71% of has been cultivated (Table 2.1). Because of the favourable climate, trees and shrubs occupy over 9% of the land area. The Aspen Parkland contains more wetlands than any other prairie ecoregion. Native grassland remaining in the 22 landscape areas of this ecoregion ranges from 6% in the Quill Lake Plain (north of the Quill Lakes) to 37% in the Lower Battle River Plain and the Ribstone Plain in the western part of the ecoregion (Map 2, Table 2.1). Invasion of woody and exotic plants is an important threat to the remaining native grassland in this ecoregion, especially in the absence of grazing and fire. These few invasive plants replace the diverse communities of grasses and wildflowers that provide habitat for many grassland animals. The high productivity of this area leads to a tendency for pastures to be overgrazed. Overgrazing weakens the plant roots, allows only the most adapted to survive and opens space for invasion of exotic plants. Although this is the most productive grassland ecoregion in the province, it is also the most fragmented (broken into small pieces, Table 3), overused and threatened by exotic species.

Like the Aspen Parkland, 20% of the remaining native grassland in the province occurs in the **Moist Mixed Grassland** ecoregion. Over 76% of the land base has been cultivated leaving only 16% of the ecoregion as native grassland (Table 2.2). In its 20 landscape areas, remaining native grassland ranges from 46% of the land area in the Neutral Hills (the most westerly area of the ecoregion) to 6% in the Griffin Plain (the Estevan/Weyburn area) (Map 2, Table 2.2).

Over 50% of remaining native grassland in Saskatchewan occurs in the Mixed Grassland ecoregion. Overall, 31% of the land area is occupied by native grassland and 62% is cultivated. There are 25 landscape areas in this ecoregion (Map 2, Table 2.3). Native grassland cover ranges from 78% in the Great Sandhills to 14% in the Lake Alma Upland in the southeast corner of the ecoregion. Large areas of this region are uneconomical for crop production due to poor soils and a hot, dry climate. This climate also reduces the establishment and spread of invasive woody and exotic plants. Producers are very conscious of how this grassland is managed because of its lower productivity and high sensitivity to overgrazing. Overall, native prairie occurs in the largest parcels (Table 3), is in best condition and is least threatened in this ecoregion.

With its long slopes and rolling hills, the **Cypress Upland ecoregion** is a unique and picturesque feature in the prairie landscape. Only 7% percent of all native grassland in the province occurs in this relatively small ecoregion. Due to soil limitations and a ranching tradition, however, this area has been least disturbed by cultivation (22%) with over 70% of the land area remaining as native grassland (Table 2.4).

Prairie Soil: Finding Our Roots

From the statistics described above, it is clear that most native grassland has been lost to agricultural cultivation. We should be proud of our agricultural heritage for it is the foundation on which this province has been built. However, fertile soils and a favourable climate are the foundation of western Canadian agriculture. Our fertile soils formed under native grasslands over almost 10,000 years since the last glaciation. Organic matter, made up of plants and animals decaying over centuries, is the source of the fertility and rich dark colour of topsoil. Therefore, the remaining native grassland is a part of our heritage that must be conserved.

Soil capability for agriculture has been mapped for the entire prairie region of Saskatchewan. This map shows where we can find good and poor soils for crop production. **Approximately 75% of remaining native grassland occurs on land that is severely limited or unsuitable for crop production** (Map 3, Table 4). Most of these areas are unsuitable for cultivation due to soil moisture limitations, stones, steep slopes, erosion, salinity, soil structure or flooding. Over 24% of native grassland is still at medium or high risk of being broken (Soil classes 1 to 3). With advances in crop development, crop varieties that can grow under drier conditions and on infertile soil may soon become available. While these advancements may be very beneficial to producers, it may also increase the threat of further cultivation of native prairie on poor agricultural land.

Some plants grow best on fertile clay soils while others are well adapted to infertile sandy soils. Some animals depend on specific plants to provide food and shelter. In order to keep the diversity of plants and animals across the prairies, we need to conserve native grassland on both fertile and infertile soils. **Only 10% of the remaining native grassland occurs on highly productive soil (i.e., Soil Class 1or 2)**. These areas are at highest risk of cultivation. They need to be saved as a benchmark for the future and a reserve of biodiversity.

Prairie Conservation Initiatives

Over 30% of the remaining native grassland is owned or managed by government agencies or conservation organizations (Table 5). Almost 45% of this native 'conservation land' (or 13% of all native grassland) is managed as Provincial or PFRA (Prairie Farm Rehabilitation Administration)

pasture. These lands are either leased to farmers and ranchers or are managed as community pastures.

An estimated 46% of conservation land (Table 5) is protected under the provincial Wildlife Habitat Protection Act. Although restricted development may be permitted, this legislation protects 13,600 km^2 (3.4 million acres) of uplands and wetlands in its natural state. Other publicly owned conservation areas include parks. Once fully established, Grasslands National Park will encompass 906 square kilometres (226,500 acres) of land, 82% of which is native grassland.

In response to the need to conserve more areas in their natural state, the Province is also in the process of establishing a system of special sites to be called the Representative Areas Network. The network will consist of existing and new wildlife lands, riparian areas, wetlands, protected areas, bird sanctuaries, ecological reserves and prairie rangelands. A Biodiversity Action Plan is also being developed to ensure that our biological resources are conserved.

A number of non-governmental agencies own and lease land to conserve wildlife habitat and biodiversity. Some of these agencies also offer stewardship programs designed to promote voluntary habitat conservation by landowners. These conservation agencies include Ducks Unlimited Canada, Saskatchewan Wildlife Federation, Nature Conservancy of Canada and Nature Saskatchewan.

The Prairie Conservation Action Plan was developed to further the interests of prairie conservation. This umbrella organization brings together representatives from government agencies, industry, conservation organizations, special interest groups and landowners to discuss issues related to prairie conservation. Chaired by the Saskatchewan Stock Growers' Association, it provides a forum for information exchange, coordinated conservation efforts and development of useful education and stewardship programs.

Landowners can use **conservation easements** to protect land from being broken. A conservation easement is a voluntary legal agreement between a landowner and a qualified conservation agency. Under this agreement, the landowner continues to own and manage the land with benefits to both the landowner and the environment.

Good Stewards

Drought stress and disturbances such as fire and grazing by huge herds of bison were common on the prairies. With time, prairie plant communities became well adapted to these disturbances. In fact, researchers have shown that moderate levels of disturbance produce the most diverse plant communities. The disturbances, however, were not continuous. Prairie fires could not burn the same piece of land year after year because it took time for litter to build up to fuel the fire. Bison migrated through the rangeland, grazing heavily for a short time but then sometimes not returning for years. The prairie had time to recover between disturbance events. In a sense, nature's balance managed the prairie.

Now that the land has been settled, it has become our responsibility to manage the prairie. The roaming herds of bison are gone and prairie fires are few and far between. Some land has been idled while other parcels have been heavily overgrazed. Poor management allows trees, shrubs, weeds and tame grasses to invade the native grassland. The plant community also becomes less diverse and less

productive. Some land managers and researchers have estimated that less than 20% of the remaining prairie is in 'good' condition (i.e., a healthy state).

It is clear then, that the future of native prairie is in the hands of its stewards. By keeping the best interests of the land a priority, good stewards reap the benefit of healthy, diverse and productive prairie. However, the cost of conserving an endangered habitat can be very high for an individual landowner. These landowners must be commended for keeping the land in its healthy, natural state. Since all of society benefits, we must encourage and support the stewardship efforts of farmers and ranchers.

Our Prairie Future

Cultivation has been noted as the major source of prairie disturbance in the past. In the future, however, other threats to native grassland may be equally as important. The impact of industrial development, expanding towns and cities, acreages, summer cottages and roads are just a few examples. Many of these disturbances fragment the landscape allowing exotic plants to spread into the prairie. Prairie disturbances such as these are inevitable as our population grows. We may reduce our impact by minimizing and restoring disturbance areas. We must also identify areas that are important for conservation where development is restricted or excluded. Detailed assessments of quality and health are needed to ensure our remaining native prairie is managed appropriately in the future. Detailed assessments of our own values and choices are needed to ensure that, in the long term, we will still have what we value most.

Resources

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Contacts

Blue Jay Bookshop, Nature Saskatchewan
206 – 1860 Lorne Street
Regina SK S4P 2L7
Ph: (306) 780-9273

- Wide range of field guides for plants, animals and insects
- Natural history books

Canadian Plains Research Center
University of Regina
3737 Wascana Parkway
Regina SK S4S 0A2
Ph: (306) 585-4758
Website: www.cprc.uregina.ca

Ducks Unlimited Canada
603-45th Street West
Saskatoon SK S7L 5W5
Ph: (306) 665-7356
or
Box 4465
Regina SK S4P 3W7
Ph: (306) 569-0424
Website: www.ducks.ca

- Prairie stewardship programs
- Wetland conservation and development
- Wildlife habitat conservation and development
- Conservation easements

Environment Canada
Canadian Wildlife Service, Prairie and Northern Region
115 Perimeter Road
Saskatoon SK S7N 0X4
Ph: (306) 975-4291
Website: www.ec.gc.ca/cws-scf/cwshome_e.html

Federation of Saskatchewan Indian Nations
Asimakaniseekan Askiy Reserve
Suite 200-103 A Packham Avenue
Saskatoon SK S7N 4K4
Ph: (306) 665-1215
Website: www.fsin.com

George F. Ledingham Herbarium
c/o Biology Department
University of Regina
Regina SK S4S 0A2
Ph: (306) 585-4254

- Plant collections
- Plant identification

Grasslands National Park
Box 150
Val Marie SK S0N 2T0
Ph: (306) 298-2166
Website:
http://parkscanada.pch.gc.ca/parks/saskatchewan/grasslands/grasslands_e.htm

Native Plant Society of Saskatchewan Inc.
P.O. Box 21099
Saskatoon SK S7H 5N9
Ph: (306) 668-3940
Website: www.npss.sk.ca

- Source list of native plant suppliers and service providers
- Workshops, meetings, field tours
- Restoration and education projects
- General plant identification inquiries

Nature Conservancy Canada
#101-2022 Cornwall Street
Regina SK S4P 2K5
Ph: (306) 787-6987
Website: www.natureconservancy.ca

- Conservation easements
- Conservation programs

Nature Saskatchewan
Room 206 – 1860 Lorne Street
Regina SK S4P 2L7
Website: www.unibase.com/~nature/
Ph: (306) 780-9273

- Conservation easements
- Environmental education

PFRA Shelterbelt Centre
Box 940
Indian Head SK S0G 2K0
Ph: (306) 695-2284
Website: www.agr.ca/pfra

- Source for trees and shrubs
- Information resources for establishing shelterbelts

Prairie Farm Rehabilitation Administration
1800 Hamilton St.
Regina SK S4P 4L2
Ph: (306) 780-5121
Website: www.agr.ca/pfra/

- Grazing and water management

Saskatchewan Agriculture and Food
3085 Albert Street
Regina SK S4S 0B1
Ph: (306) 787-5140
Website: www.agr.gov.sk.ca

- Grazing and water management
- Noxious weed list

Saskatchewan Burrowing Owl Interpretive Centre
c/o Moose Jaw Exhibition Company Ltd.
250 Thatcher Drive East
Moose Jaw SK S6J 1L7
Ph: (306) 692-1765

Saskatchewan Conservation Data Centre
3211 Albert St.
Regina SK S4S 5W6
Ph: (306) 787-5021
Website: www.biodiversity.sk.ca
- Rare plants and animals information
- Plant and animal inventory and distribution

Saskatchewan Environment and Resource Management
3211 Albert St.
Regina SK S4S 5W6
Ph: (306) 787-2314
Website: www.gov.sk.ca/serm/
Wildlife and habitat management for wildlife
- Parks and recreation
- Conservation easements
- Representative Areas Network
- Biodiversity Action Plan

Saskatchewan Indian Cultural Centre
103B - 205 Packham Avenue
Saskatoon SK S7N 4K4
Ph: (306) 373-9901
Website: www.sicc.sk.ca

Saskatchewan Prairie Conservation Action Plan
Box 4752
Regina SK S4P 3Y4
Ph: (306) 352-0472
Website: www.pcap-sk.org
- Multi-stakeholder group addressing issues related to prairie conservation
- Field tours, prairie management, educational events
- Key contact for conservation issues

Saskatchewan Purple Loosestrife Eradication Project
115 Perimeter Road
Saskatoon SK S7N 0X4
Ph: (306) 975-4101

Saskatchewan Wetland Conservation Corporation
#101-2022 Cornwall Street
Regina SK S4P 2K5
Ph: (306) 787-0782
Website: www.wetland.sk.ca
- Native Prairie Stewardship Program
- Streambank Stewardship Program
- Grazing and water management
- Plant identification

Saskatchewan Wildlife Federation
444 River St. W,
Moose Jaw SK. S6H 6J6
Ph: (306) 692-7772

Saskatchewan Stock Growers' Association
Box 4752
Regina SK S4P 3Y4
Ph: (306) 757-8523

Semiarid Prairie Agriculture Research Centre
(Agriculture and Agri-Food Canada)
Box 1030
Swift Current SK S9H 3X2
Ph: (306) 778-7200
Website: www.res.agr.ca/swift/welcome.htm

Society for Range Management
3085 Albert Street,
Regina SK S4S 0B1
Ph: (306) 787-7712

Tourism Saskatchewan
1922 Park Street
Regina SK S4P 3V7
Ph: (306) 787-2300
Website: www.sasktourism.com

University of Saskatchewan
Department of Plant Sciences
51 Campus Drive
Saskatoon SK S7N 5A8
Ph: (306) 966-4955
Website: www.usask.ca/agriculture/plantsci/

W.P. Fraser Herbarium
University of Saskatchewan
51 Campus Drive
Saskatoon SK S7N 5A8
Ph: (306) 966-4968
- Plant collections
- Plant identification

Table 1. Prairie Ecozone

Ecoregion	Land Area (km^2)	% Native Grassland
Aspen Parkland	81,693	13
Moist Mixed Grassland	67,832	16
Mixed Grassland	86,422	31
Cypress Upland	5,019	71
Ecozone Total	**240,966**	**21**

*Cover class data derived from the Southern Digital Land Cover 1994 Digital Data provided by the Prairie Farm Rehabilitation Administration. There is some variation in the percentages as a result of rounding.

Table 2. Vegetation Cover Saskatchewan Prairie Ecoregions

TABLE 2.1. ASPEN PARKLAND

Landscape Area Code	Landscape Area Name	Land Area Total (km²)	Cover Type (%) Native Grassland	Cropland & Seeded Pasture	Trees & Shrubs	Water & Wetland	Other
H1	Lloydminster Plain	7,392	18	64	13	4	1
H2	Lower Battle River Plain	1,481	37	31	27	5	0.4
H3	Ribstone Plain	1,145	37	15	34	14	0.1
H4	Provost Plain	342	23	67	2	7	1
H5	Maymont Plain	2,498	12	75	5	7	1
H6	Whitewood Hills	3,453	19	57	17	7	0.3
H7	Hafford Plain	727	23	61	12	4	0.4
H8	Waldheim Plain	4,135	12	76	5	6	1
H9	Cudworth Plain	2,347	9	76	5	9	1
H10	Quill Lake Plain	10,537	6	79	4	10	1
H11	Touchwood Hills Upland	10,301	11	74	10	5	1
H12	Whitesand Plains	1,634	30	39	21	9	1
H13	Yorkton Plain	6,204	12	76	6	6	1
H14	St. Lazarre Plain	623	30	41	23	4	3
H15	Melville Plain	7,961	9	77	9	3	3
H16	Indian Head Plain	3,394	14	76	4	4	1
H17	Kipling Plain	5,484	12	77	7	4	1
H18	Moose Mountain Upland	2,740	11	81	3	4	1
H19	Moose Mountain	1,174	13	19	50	18	1
H20	Gainsborough Plain	5,935	8	84	5	2	1
H21	Moose Mountain Creek Plain	1,385	28	62	5	5	0.4
H22	Oak Lake Plain	801	13	80	5	2	1
Aspen Parkland Total		**81,693**	**13%**	**71%**	**9%**	**6%**	**1%**

TABLE 2.2. MOIST MIXED GRASSLAND

Landscape Area Code	Landscape Area Name	Land Area Total (km²)	Cover Type (%) Native Grassland	Cropland & Seeded Pasture	Trees & Shrubs	Water & Wetland	Other
K1	Neutral Hills	1,246	46	47	1	6	0.3
K2	Tramping Lake Plain	6,776	16	75	1	8	1
K3	Senlac Hills	603	32	54	4	10	1
K4	Biggar Plain	572	37	47	10	6	0.4
K5	Bear Hills	1,201	30	63	3	4	0.2
K6	Rosetown Plain	4,232	10	86	0.3	3	0.4
K7	Goose Lake Plain	5,105	18	70	4	8	1
K8	Saskatoon Plain	1,076	14	66	6	4	10
K9	Moose Wood Sand Hills	2,131	39	34	23	4	1
K10	Minichinas Upland	979	18	72	2	8	0.2
K11	Elstow Plain	4,814	11	80	1	7	1
K12	Allan Hills	1,184	19	73	0.2	8	0.1
K13	Arm River Plain	7,448	11	83	2	4	1
K14	Last Mountain Lake Plain	2,124	20	66	0.2	14	1
K15	Strasbourg Plain	4,353	10	84	3	3	1
K16	Eyebrow Plain	2,709	24	69	3	4	0.4
K17	Regina Plain	9,090	7	88	1	1	3
K18	Griffin Plain	6,405	6	86	1	6	2
K19	Trossachs Plain	4,047	19	72	2	6	1
K20	Souris River Plain	1,738	45	39	5	5	5
Moist Mixed Grassland Total		**67,833**	**16%**	**76%**	**3%**	**5%**	**1%**

TABLE 2.3. MIXED GRASSLAND

Landscape	Landscape	Land Area	Cover Type (%) Native	Cropland &	Trees &	Water &	Other

Area Code	Area Name	Total (km²)	Grassland	Seeded Pasture	Shrubs	Wetland	
M1	Kerrobert Plain	2,659	23	69	1	7	1
M2	Sibbald Plain	1,147	18	76	0.2	5	0.4
M3	Oyen Upland	1,499	44	52	0.2	3	0.4
M4	Eston Plain	9,126	18	77	1	4	1
M5	Bad Hills	1,614	35	61	1	3	0.2
M6	Acadia Valley Plain	136	26	72	0.1	1	0.4
M7	Bindloss Plain	767	37	49	12	2	0.2
M8	Hazlet Plain	2,204	17	79	1	3	0.3
M9	Schuler Plain	1,750	37	61	1	2	0.1
M10	Maple Creek Plain	2,661	73	20	2	5	0.2
M11	Great Sand Hills	1,243	78	13	8	1	0.1
M12	Antelope Creek Plain	2,678	19	76	0.2	4	1
M13	Gull Lake Plain	1,520	42	53	2	3	1
M14	Beechy Hills	2,857	40	52	2	6	0.3
M15	Coteau Hills	1,498	16	75	6	3	0.2
M16	Chaplin Plain	6,713	22	62	3	12	1
M17	Swift Current Plateau	7,588	19	78	1	2	1
M18	Wood River Plain	10,076	15	81	0.4	4	1
M19	Dirt Hills	3,349	33	53	11	3	1
M20	Coteau Lakes Upland	6,729	31	58	2	7	1
M21	Lake Alma Upland	2,139	14	73	4	8	2
M22	Wood Mountain Plateau	8,884	55	39	2	4	1
M23	Climax Plain	3,611	29	67	0.3	3	1
M24	Old Man on his Back Plateau	1,373	67	31	0.3	1	1
M25	Wild Horse Plain	2,601	73	25	0.2	2	1
Mixed Grassland Total		**86,422**	**31%**	**62%**	**2%**	**5%**	**1%**

TABLE 2.4. CYPRESS UPLAND

Landscape Area Code	Landscape Area Name	Land Area Total (km²)	Cover Type (%) Native Grassland	Cropland & Seeded Pasture	Trees & Shrubs	Water & Wetland	Other
N1	Cypress Slope	947	66	29	3	2	0.3
N2	Cypress Hills	4,073	72	20	6	2	0.2
Cypress Upland Total		**5,020**	**71%**	**22%**	**5%**	**2%**	**0.2%**

Table 3. Number and size of remaining natural habitat patches in southern Saskatchewan by ecoregion. Sample sizes refer to number of 1:50,000 map sheets examined.*

Ecoregion	<10 ha (<25 ac)	11-100 ha (25-250 ac)	101-1,000 ha (250-2500 ac)	> 1,000 ha (>2,500 ac)
Aspen Parkland (n=29)	24,346	888	144 (0.6%)	16 (0.1%)
Moist Mixed Grassland (n=18)	23,444	1,042	192 (0.8%)	43 (0.2%)
Mixed Grassland (n=88)	30,339	2,017	372 (1.1%)	80 (0.2%)
Overall	116,912	5,637	980 (0.8%)	192 (0.2%)

*Reference: James, P.C., K.M. Murphy, F. Beek and R. Sequin. 1999. The biodiversity crisis in southern Saskatchewan: a landscape perspective. Pages 13 to 16 in J. Thorpe, T.A. Steeves and M. Gallop (eds.) Proceedings of the Fifth Prairie Conservation and Endangered Species Conference. Provincial Museum of Alberta, Edmonton. Natural History Occasional Paper No. 24.

Note: 250 hectares (625 acres) is considered the minimum required to support representative levels of native species diversity. Reference: P.C. James. 2000. Presentation at Native Plant Society of Saskatchewan Annual General Meeting.

Table 4. Soil capability classification for native dominant grassland (NDG) in the Prairie Ecozone.

Soil Class	Soil Class Description	Prairie Ecozone		NDG		
		Land Area (km^2)	% of Ecozone	Land Area (km^2)	%NDG	% of Ecozone
1	No Significant Limitations	2,696	1	231	1	0.1
2	Moderate Limitations/Moderate Conservation Practices	70,025	29	5,072	10	2
3	Moderately Severe Limitations	65,901	27	7,229	14	3
4	Severe Limitations	55,012	23	14,758	29	6
5	Forage Crops Improvement Practices Feasible	23,944	10	12,609	24	5
6	Forage Crops Improvement Practices Not Feasible	19,441	8	11,125	22	5
Urban	Urban Area	249	0.1	9	0.02	0
Water	WAter	3,560	2	610	1	0.3
Total		240,828	100%	51,643	100%	21%

* Soil capability for agricultural classification derived from the Atlas of Saskatchewan Digital Data Set, 1999.

Table 5. Native grassland within conservation areas of Saskatchewan.[1]

Conservation Area (CA) Types	Conservation Areas		Native Dominant Grasslands (NDG)		
	Area[2] (km^2)	% of ecozone	Area (km^2)	% of CA	% of NDG in ecozone[3]
Ramsar Site Wetlands of international importance consisting of marshes, swamps and other wetlands of value for flood control, nutrient production, wildlife habitat and other related purposes.	595	0.2	122	20.6	0.2
Migratory Bird Sanctuary Designated to protect migratory bird, their nests, eggs and habitat.	486	0.2	17	3.5	<0.1
National Historic Park Federally owned lands designated to: a) commemorate a historic event; or b) preserve a historic landmark or object of historic, prehistoric or scientific interest of national significance.	12	<0.1	5	43.1	<0.1
National Park Relatively large tracts of land and/or water designated and managed by the federal government to protect representative natural areas or ecosystems of Canadian or international significance.	914	0.4	748	81.8	1.4
National Wildlife Area Designated to protect and maintain important or unique federally owned lands for migratory birds and other wildlife.	193	0.1	110	56.7	0.2
PFRA Community Pasture Marginal agricultural lands established to accommodate sustainable grazing practices and other compatible land uses, such as wildlife habitat, recreation and mineral extraction.	6,594	2.7	5,477	83.1	10.6
Ecological Reserve Provincial lands sustaining or associated with unique or representative parts of the natural environment.	8	<0.1	2	26.3	<0.1
Provincial Historic Site Small parcels of crown land containing prehistoric or historic resources of provincial significance.	1	<0.1	1	69.6	<0.1
Protected Area Designated crown lands which serve to protect and preserve site-specific cultural and natural resources of provincial significance.	54	<0.1	31	58.6	0.1
Provincial Community Pasture Large blocks of provincial crown land assembled to provide supplementary grazing for livestock producers and to maintain marginal lands in permanent cover. They are managed to accommodate multiple uses, such as wildlife habitat, recreation, heritage interests and mineral activities.	2,317	1.0	1,849	79.8	3.6
Provincial Heritage Property Heritage property is any property, whether a work of nature or of man, that is of interest for its architectural, historical, cultural, environmental, aesthetic or scientific value.	<1	<0.1	<1	100.0	<0.1
Provincial Parks Natural Environment - Large natural tracts of land protecting representative and unique landscapes, offer public recreational opportunities. Wilderness - Large & remote tracts of undisturbed crown land in a natural state, allow the pursuit of low intensity & non-mechanized wilderness recreation.	845	0.4	243	28.8	0.5
Provincial Recreation Site Small areas of crown land developed to take advantage of particular recreation activities or facilities (e.g., campground, picnic area or lake access).	29	<0.1	13	44.3	<0.1
Wildlife Development Fund Land[4] Land designated to conserve and improve critical habitat primarily for white-tailed deer, as well as other important game and endangered species.	284	0.1	89	31.2	0.2
Wildlife Habitat Protection Act[4] Lands critical to wildlife survival including rare and endangered species. They protect remaining "critical" areas on crown land without affecting existing compatible traditional uses.	9,730	4.0	7,575	77.8	14.7
Wildlife Refuge These lands are constituted as areas for the protection, propagation, perpetuation, management, control, regulation and/or enhancement of wildlife and its habitat.	37	<0.1	13	35.6	<0.1
Nature Conservancy of Canada NCC is Canada's only national charity dedicated to preserving ecologically significant areas through outright purchase, donations and conservation easements.	178	0.1	78	43.6	0.2
Total in Conservation Areas[5]	**22,277**		**16,373**	**73.5**	**31.7**

[1] Reference: Gauthier, D.A. and E. Wiken. (in press). Monitoring the conservation of grassland habitat, Prairie Ecozone, Canada. Proceedings of the 7th National Science Meeting of the Ecological Monitoring and Assessment Network, May 2-5, 2001, University of Calgary, Calgary, Alberta.

[2] Land area data were calculated from geographical information systems maps and may not equal values published by agencies managing the CAs.

[3] Percentage of all NDG in Prairie Ecozone accounted for in CA.

[4] These CA types are referenced by quarter section centroids, i.e., they are not available as polygons. Therefore, the CA types can't be intersected with cover types to determine the extent of each land cover type relative to CAs. Therefore, reliable area totals by cover type cannot be obtained.

[5] Some areas are designated by more than one CA type. Thus when summing across CA types, cases of double counting may occur.

Appendix 'E': Press Release

PRESS RELEASE

Landowners Critical To Saving Prairie Heritage
By Andrew M. Hammermeister
February 13th, 2002

"Only 21% of Saskatchewan's native grassland remains undisturbed," reveals a new report by the Native Plant Society of Saskatchewan and Canadian Plains Research Center. This startling fact suggests that the native grassland that once covered the prairies before settlement is at risk of being lost completely from some regions. According to the Saskatchewan Agriculture and Food funded publication "Saskatchewan's Native Prairie: Taking Stock of a Vanishing Ecosystem and Dwindling Resource", some regions of the province have less than 6% of the native grassland remaining. In this case 'native' refers to the grassland, including plants and animals, that was present before the land was settled.

The prairies were once covered by different communities of plants and animals depending on the soil and climate of the region. With settlement came a variety of forms of disturbance ranging from cultivation, road and railway construction, mining, development of towns, and the list goes on. The federal government offered incentives for the land to be cultivated. The rich soil beneath the native grassland became the foundation for crop production across the prairies. Cultivation of poor soils, however, not only destroyed the ecosystem but created serious soil erosion problems and generated little economic return.

Researchers and land managers are now beginning to realize, however, that the entire ecosystem is at risk of being lost. Approximately 75% of the remaining native grassland is found on soils with severe limitations for agriculture. This is land that is generally too dry, stony, sandy, saline, steep or rough for sustainable crop production. Most of this land is in the southwest corner of the province and along valleys and coulees. This means that only 25% of the remaining native grassland, or 5% of all the grassland in the prairie region of Saskatchewan, is left on 'good' agricultural soil. The unique communities of plants and animals that survived in these parts of the province are all but gone.

According to Dr. Paul James (Saskatchewan Environment and Resource Management) and his colleagues, most patches of native prairie are less than 25 acres in size. Larger parcels of land sustain greater biodiversity. As part of a larger undisturbed landscape, a 10-acre parcel of rolling native grassland can contain over 200 different kinds of plants not to mention other wildlife.

An estimated 31% of the remaining native prairie is found in 'Conservation Areas'. Conservation Areas include protected wildlife habitat, parks, community pastures, and historic sites. The remaining native prairie is privately owned or provincial lease land. Native prairie needs to be properly managed (i.e. not left idle nor abused). This means the future of native grassland is in the hands of ranchers and farmers who manage them. There are many excellent stewards of the native prairie among them. Moderate, well-managed grazing does not harm native prairie, and in many cases will increase the diversity of plants and animals living there. The sustainable use of native prairie is in the best interest of everyone.

For more information or free copies of the publication "Saskatchewan's Native Prairie: Taking Stock of a Vanishing Ecosystem and Dwindling Resource", contact:

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